RAILROAD MOTOR CAR SERVICES.

An extract is printed this week, in the General News Section, from a paper which gives a comprehensive review of the progress which has been made in Great Britain in the use of rail motor cars (*Transport and Railroad Gazette*, Nov. 11, 1904). The subject is receiving the greatest attention throughout England at the present time. For example, the Great Western is now building steam motor cars as fast as its Swindon works can turn them out, and proposes to very greatly extend its motor car services, of which there are already some 16 in operation, involving at present the use of approximately 25 cars. These Great Western cars are 59 ft. 6¾ in. long over headstocks, 8 ft. 6¾ in. wide and 8 ft. 2 in. high inside, with steel underframes and a wheel base of 48 ft. 9 in. The passenger compartment is 39 ft. 6 in. long, the motor 14 ft. long, and the vestibule 4 ft. 9 in. long. The passenger compartment holds 52 passengers, 16 in cross seats and 36 in the longitudinal seats; the arrangement being substantially the same as that of the cars in use on the lines of the Interborough Company in New York. The engine has a vertical boiler with a cone top, 4 ft. 6 in. in diameter, and with 477 tubes 1⅛ in. in diameter. The height of the boiler is 9 ft. 6 in.; working pressure 160 lbs., and a total of 672.33 sq. ft. of heating surface, to which the tubes contribute 625.58 sq. ft. and the fire-box 46.75. The grate area is 11.54 sq. ft. and a 450-gallon water tank is carried under each coach. The cylinders are 12 in. x 16 in., fixed horizontally and driving the trailing pair of wheels, which are coupled to the leading wheels. This description applies to the cars used in the suburban services. The cars used on branch lines have the same outside dimensions and characteristics and the same engine, but the passenger compartment is made somewhat shorter to allow for a baggage compartment 6 ft. 3½ in. long. These cars seat 46.

The Great Western cars afford a characteristic example of most of the steam motor cars with which experiments are now being made in England, subject, of course, to certain modifications. A couple of petrol-electric cars are in use on the North Eastern, and much interest is being shown in this type of motor car for the reason that it reduces the crew of the car to two men instead of three. The light train in England carries a normal crew of three men; engineer, fireman, and a guard who also performs the duties of a flagman, but who only has a part of the work of the conductor on an American train, for the reason that tickets are usually collected at the station platforms. Therefore, a steam motor car does not effect any saving in train crews, in English practice. This statement applies only to the steam cars which are now in use on English roads. Other types of steam cars have been designed which do not require the services of a fireman. With the certain development of the flash boiler, the arguments in favor of the petrol car will have less force. Theoretically the thermal efficiency of a petrol motor is greater than that of a steam boiler and engine, but saving of fuel is not the only consideration. The steam car has the advantage of great flexibility and certainty of action, and even if the petrol car shows a slight saving in the fuel cost, it does not follow that it is necessarily the most economical type of car. The chief economies of motor car service, as outlined in further detail in the reprint from the English paper, lie in wage saving, small service unit, station force, and in the avoidance of a considerable part of the switching necessary for a train.

The engines of the best railroad motor cars of the present day leave much to be desired in simplicity, space required and reliability, but builders of these cars owe an important debt to the automobile manufacturers who have for many years been trying to meet a similar problem, but one which is in many respects harder to solve. It seems evident, regardless of the attitude of railroad men to motor cars, that the automobile makers will keep on with their experiments, and that the time will surely come when a satisfactory and economical engine can be found to drive rail motor cars. There are countless localities in this country where there is needed a frequent service, conducted in small units, at a low cost—the kind of service for which a rail motor car is especially well adapted; yet, so far as we know, there is not a single rail motor car service at present in regular operation in the United States. The Burlington is understood to have a petrol-electric car about ready for use at the present time, but no reports are available from it as yet. It is well known that a steam motor car, equipped with a small locomotive engine of the ordinary type, was tried several years ago on the New York Central and the Boston & Albany, but failed to show sufficient economies to create a demand for other cars of the same type. It is hard to say at the present time, as the result of actual tests, whether petrol-electric cars can show a permanent saving in fuel and up-keep as compared with steam motor cars, but the engine requires so little attention while in service that even in the present state of the art the petrol cars can be counted on to operate with a crew of two men.

British railroad managers have found that rail motor cars are very effective in meeting certain forms of trolley competition. Assuming that the advantage possessed by trolley lines in handling short-haul passenger traffic is derived mainly from two sources—the possibility of running a frequent service in small units and the benefit derived from the use of city streets as a terminal—it is evident that motor cars can compete actively with one of these functions; that of the frequent service; and their advantage in having a private right of way between stops may compensate, at least in part, for their disadvantage in not being able to collect and set down passengers in the streets of the cities through which they pass. It is probable that there are a good many places in the country to-day where trolley roads are making havoc with short-haul profits, where a rail motor car service would redeem much of the lost business and share in the new business created by the trolley lines. Besides this competitive use of the cars, which is comparable with that of the suburban cars on the Great Western, there remains in this country, as in England, the advantage of being able to conduct light branch line business at smaller cost than can be done with steam trains. A road like the Great Northern should be able to maintain a large number of motor car services at considerably less cost than that of the present passenger train service on some of its northern branches, if the construction details can be worked out so as to avoid breakdowns and an undue repair account. Or, again, a road like the Florida East Coast, which has a heavy passenger traffic for an extremely short season, might well find economy in the use of these cars to handle extra business which is merely temporary. It would seem that these three fields alone—services which compete with trolley lines, under certain conditions; branch line services, and services in which the traffic is subject to considerable fluctuations—would offer an attractive field for experiment with rail motor cars, without consideration, for the moment, of some of the other uses to which the cars are now being put in England. Moreover, it well may be that the rail motor car can serve a useful purpose as a forerunner of electrification. Wherever its use results in developing a large short haul business, it may be concluded that electrification is worth considering, and the motor car can be moved on to exploit new fields.

The most-talked-of fact in connection with the railroad accident records of the last few years is that the railroads of Great Britain and Ireland were worked for 15 months (ending with March, 1902) without causing the death of a passenger in a collision or derailment. This is a remarkable record, indicating sound structures, correct methods, efficient men and good discipline. Comparing it with the record in America, we cannot avoid self-reproach. But it must be borne in mind that this one item is not the "whole thing." The Vandalia Line (Indianapolis to St. Louis, 242 miles) has killed only one passenger in a train accident in 50 years; and that accident did not belong to the class that causes our present reproach—collisions; it was a derailment, due to a broken rail. This fact was stated recently by an officer of the Vandalia before the St. Louis Railway Club, as reported in another column of this paper. At the same time the Vandalia has had collisions, like other single-track roads. The English lines had some train accidents in their 15-months' record referred to, and have killed passengers since then. We shall not in this place take the reader's time to elaborate the reasoning from these facts; many of the conclusions are obvious. The question of safety in railroad travel is not to be settled by a newspaper article or two. This Vandalia record, and that of the Albany & Susquehanna, referred to last week, bring out another phase of the subject; the difference in the danger on single-track roads with light or moderate traffic as compared with double-track lines with heavy or crowded traffic. In the statement concerning the Albany & Susquehanna attention was called to the fact that a comparison of passengers killed in proportion to the number carried would show that road's record to be much better than the English

record. By taking a sufficiently long term of years a short road in the thinly settled parts of New York State can be compared with a single year on the thousands of miles of roads in the densest parts of England. A statement of similar import has been published in Chicago concerning the accident record on the Southern Pacific for a recent period. Finding that the average deaths and injuries per train mile equal only one-half the average per train mile in the whole United States, and assuming that this difference is due to the good discipline of the Southern Pacific, the conclusion is offered that if the rest of the roads of the country would adopt S. P. discipline the casualties everywhere would be reduced one-half! Here, again, we leave the reader to draw his own conclusions. Just how much a passenger gains in safety on a line where there is only one train a day, as compared with a four-track line that is constantly crowded, no one can calculate; but that the difference is enough to completely vitiate such comparisons as this which comes from Chicago is too patent to need stating. It is not to be supposed that the management of the Southern Pacific fathers these comparisons; but some railroad men do seem to imagine that comfort can be got out of that kind of arithmetic, hence this notice of the matter. All these various sophistries make no difference with the central facts: That large numbers of deaths are caused on American railroads by collisions, and that the collisions, occurring by the hundreds every year, are due to causes which in very large measure can be quickly done away with, and at moderate cost.

The recent large orders for cars and locomotives from all parts of the country cause the natural query whether this increase in equipment contracts is for the purpose of relieving temporary congestion, or in anticipation of a larger movement of traffic. The increased activity along these lines, which started in the latter part of September, does not seem to be due to a universal state of congestion, as was the case in 1902. Serious car shortage is reported only in the northwest, while in the middle west and east the congestion does not appear to be abnormal except in certain parts of New England. It seems rather to be due to the feeling which prevails that conditions are favorable for a good year in 1905 in all branches of business throughout the country. The increase in orders is in part the indirect result of a rather poor year in 1903, and some of the contracts recently placed were undoubtedly held over from last year because many of the railroads found it so hard to secure the necessary money that they preferred to get along with what equipment they had, at a time when gross earnings were slackening. The situation this year is the reverse, and it is now possible to obtain sufficient money for equipment at reasonable rates. The tremendous recovery in the market value of the more important equipment companies from the low prices of 1903, shows the disparity between the orders on hand last fall, and the orders now on hand. In December, 1903, many of the equipment companies were running their shops with half their forces, and with only a meagre amount of orders on their books. In direct contrast to this, many of the works are now running full force with orders booked ahead. Carefully compiled figures show that during the past two months orders have been placed for 60,000 cars and about 800 locomotives. The greater part of these orders will not show in the year's output, as they will not be finished until the first part of 1905. In fact the estimate for the car and locomotive output for 1904 will probably fall far short of the figures for 1903. Present indications point to a general revival in business and heavier traffic in 1905, and orders for new equipment and rolling stock should show a steady increase from now on, to meet the prevailing larger traffic movement.

In the message sent by President Roosevelt to Congress this week, industrial and commercial matters are made more prominent than anything else, the relations between capital and labor forming the subject of the opening chapter. No important new proposals are offered, however, and the message is significant of general purposes rather than of intention to do any specific thing. The same may be said of the chapter on industrial corporations; it is a general plea, based on the theory that the powers of the Federal government should be used to the fullest extent to right all wrongs. The President endorses the Interstate Commerce Commission's proposal for compulsory block signaling, and asks for a law limiting trainmen's working hours and establishing tests of their qualifications. The Commission, he says, should not only receive monthly reports of accidents, but should investigate accidents in cases where it is deemed desirable to do so. The most radical passage affecting railroads is that endorsing the proposition to empower the Interstate Commerce Commission to correct unjust freight rates. The President accepts the fallacious notion that correcting rates which have been complained of is not so great a power as that to make rates *de novo*, and he goes the whole figure with the Western Governors and the other promoters of the bill presented in Congress last session by Senator Quarles. Whether the President's action will add force to this movement it is impossible to predict; but, whatever the outcome, it is unfortunate that, while so warmly espousing the cause of the radicals he did not listen for a moment to the conservative radicals—those who wish to give the Commission more power, but who look a little into the future. Even so wild a Populist as Senator Tillman recognized the need of making the Commission a thoroughly judicial body, and of having such partisan work as Commissioner Prouty sometimes indulges in relegated to a non-judicial body. The Commission can never serve the public acceptably as a judicial body until it is clothed with all of the attributes of our high courts. Even then the vast extent of our territory might necessitate local subsidiary interstate commerce courts.

The earnings and expenses of the Pennsylvania system are always of especial interest as an index of the general traffic condition of the country, because the lines involved cover a territory so large and so complex that temporary local disturbances do not magnify the general result disproportionately. It is of especial interest to see, therefore, that the statement of earnings and expenses for the month of October, 1904, shows the first increase in gross for some months. In August gross earnings of the lines directly operated decrease $741,400 as compared with August, 1903. In September this decrease was cut down to $292,100 as compared with the year previous, but in October there was an actual gain of $3,100, a figure small in itself but significant as indicating what appears to be the turning point. A year ago at this time the monthly statements all showed the somewhat disheartening increase of expenses at a more rapid rate than the increase of earnings, but by a rather radical curtailment of extraordinary expenditures and by good management and careful operation this was at last remedied, so that in all three of the months now under review, even while gross earnings were showing a decrease, operating expenses were showing a larger decrease, and net earnings gained steadily from an increase of $152,000 over 1903 last August to $257,900 in September and $358,800 in October. This is on the lines directly operated. On the Philadelphia, Baltimore & Washington, with much smaller totals, the results have not been so good. On that line gross earnings increased in August but decreased in September and October. Net earnings increased in August but decreased in September and October. On the Northern Central gross earnings increased in all three of these months, with a particularly large increase in October, and net earnings also increased right along. On the West Jersey & Seashore both gross and net earnings showed a decrease in August and both gross and net have showed increases in both September and October. On the Lines West of Pittsburg and Erie, directly operated, the results are similar to those of the lines east. Gross earnings decreased considerably in August, somewhat less in September, and showed a small increase in October, while expenses were kept down so well that net earnings showed a good increase in all three of the months.

For the first time in the annals of transportation we are able to set forth in stately figures the magnitude of an up-to-date football match in its relations to railroad traffic. On Saturday, Nov. 19, there was played at New Haven the climacteric Yale-Harvard game cheered by 32,000 spectators not counting unreserved seats in the treetops. On that red lettered day of blended glory and gore the New York, New Haven & Hartford Railroad Company sold at the three stations, New York, Boston and Providence, a total of 8,471 round trip tickets connoting, by the usual formula of computation, 16,942 passengers, and actually bringing in $35,632. Tickets sold at other stations carried the impressive total up to about 32,000 passengers, with receipts of some $53,000; and the latter figures presumptively do not include football passengers before and after the day of the game who would probably add some thousands to the returns. Last year, subtracting from its passenger department earnings the receipts from express, mails and extra baggage, the New Haven Company earned $21,210,259, or, approximately, $57,594 per average day. Thus a single big football game brought in receipts about equal to a single day's gross passenger earnings on a system with a total track mileage of 4,154 miles, whose passenger earnings about equal those from freight and whose high passenger earnings per mile are unique in the railroad traffic returns of the country. But this is not all: It appears by comparison of the receipts with those of the Yale-Harvard game

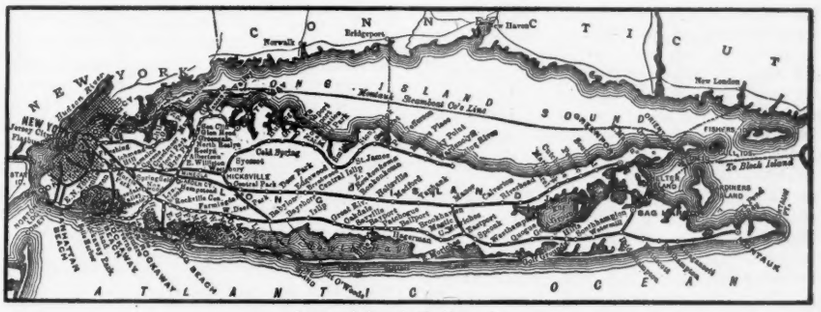
at New Haven in 1902, two years ago, that the conviction of football devotees that last month Yale had a so-called "cinch" on the great match cost the railroad company probably about 2,000 passengers and $6,000 receipts. Under such lucrative conditions railroads may well view with alarm the efforts of humanitarians to abolish the gridiron on which so many academic youths are basted and scored.

The annual report of the Board of Rapid Transit Commissioners of the city of New York, which is now at hand, loses much of its current interest from the fact that it covers the year ending Dec. 31, 1903, and deals, in great part, with a discussion of engineering and construction problems which were uncompleted during the time under review but which have since passed into history. In view of the papers printed in the *Railroad Gazette* at the time the subway was opened, taking up a number of features of the work in considerable detail, it seems unnecessary to make further reference to the engineering matter contained in the present report. The most interesting work which now lies before the Board of Rapid Transit Commissioners, following after the extremely successful completion of their original work in building the subway, is the planning and carrying out of further underground rapid transit routes. It will be recollected that in February, 1903, Mr. Parsons presented a report on a comprehensive plan for rapid transit in the boroughs of Manhattan and the Bronx, and that in the month following this report was perfected by the addition of corresponding plans for the boroughs of Brooklyn and Queens. It does not appear that the present report can add very much to the situation as then presented, except with regard to the opinion of counsel that no new rapid transit construction of any large importance can be undertaken until legislation is secured covering two points: the enlargement of the power of the city to borrow money for rapid transit construction, and the removal of the existing doubt as to the power of the Rapid Transit Board to lay out routes which should embrace the bridges belonging to the city. Both of these objects can be secured by very slight amendments to the existing rapid transit legislation.

Long Island Railroad.

With exceedingly great potential strength, owing to a practical monopoly of a suburban field which is bound to have a tremendous development in the next few years, the Long Island is at present laboring under serious difficulties in the cost of its service. From the nature of its geographical position the road is primarily a passenger carrier, although an excellent short-haul freight business has been built up and is steadily increasing; but passenger, express and mail traffic constitute 70 per cent. of the gross earnings. This traffic has been showing good increases steadily, year after year, but the necessity for development, together with certain abnormal conditions which have arisen within the last few years, have increased fixed charges and the cost of transportation at a rate so much faster that while gross earnings have increased almost a million dollars in the last three years, to a total of $6,835,848 this year, net earnings from operation have decreased steadily during the same period; while the charges against gross income have brought net income down from a profit of $544,255 in 1902 to a deficit of $275,205 in 1904.

Besides the universal increase in wages, two or three items stand out significantly in the reports of the last few years as indicating the reason for the great increase in expenses. For example, in 1901, with a total revenue train mileage of 3,456,305, fuel cost $403,173. In 1904, while revenue mileage had increased to 4,387,430, 27 per cent., the cost of fuel had increased to $838,422, 108 per cent. The reason for this disproportion between fuel cost and traffic moved is due primarily to the fact that because of the termini and terminal mileage within the limits of Greater New York, the road has been compelled to use anthracite coal instead of bituminous on most of its engines. It is rather curious that this is not explained in any of the company's reports, as the *prima facie* showing of coal cost is very bad, although due to causes beyond the control of the railroad. Another interesting item in the report is the charge for balance of car service under the per diem rule. In 1902 the car mileage balance against the road was $17,951. This current year it was $199,711. It is easy to understand that the Long Island, reached only by car floats at one terminus and not reached at all at the other, is singularly badly placed geographically for the prompt handling of foreign cars; that its business is really a switching business, although it participates in through rates. Owing to the efforts of the General Manager, Mr. Potter, the car service charge will in future be on the basis of a switching company, so that there will be a large reduction in the per diem balance next year.



Long Island Railroad.

To these heavy charges for coal, wages and car service, exclusive of the maintenance charges, both for way and structures and for equipment, which have been increased largely, must be added the interest on the new securities authorized to provide absolutely necessary funds for the proper handling of local traffic, the elimination of grade crossings and the electrification of a portion of the system, besides the outlay for double tracking, yards and other terminal facilities, required for the through traffic to be exchanged between the Pennsylvania, the New Haven road and the Long Island. A 4 per cent. refunding mortgage was authorized, to aggregate $45,000,000, of which $26,605,000 has been reserved for all underlying liens, and $10,000,000 of the balance sold to meet part of the expenditures mentioned above. The mortgage is dated September 1, 1903, and runs for 45½ years, and the Pennsylvania Railroad guarantees principal and interest of the ten millions of bonds referred to as having been issued. This mortgage is of the same authorized amount as, and practically takes the place of, the unified mortgage, under which $9,673,000 bonds had been issued. The unified mortgage was for the same authorized amount, but was too restricted in its scope to meet the changed conditions of the property, and no further issues of bonds will be made under it.

By means of a rather elaborate classification, the Long Island has for some years apportioned earnings and expenses between freight and passenger traffic. Where the charge cannot be divided specifically, the pro rating is on a train mileage basis. According to this somewhat unsatisfactory division, it is interesting to see that while the average passenger mile earnings this year were 1.44 cents, the average passenger mile cost was 1.548 cents, showing that the traffic was handled at a considerable loss. It is worthy of mention that any train mileage apportionment of general expenses between passenger and freight puts passenger traffic at some disadvantage, owing to the smaller trains. The total passenger earnings per train mile are given as 97.5 cents, and the general passenger expenses per train mile as 104.8 cents. The freight showing is better, although the aggregate amount involved is smaller. Freight earnings per revenue freight train mile are given as 401.2 cents, and freight expenses as 206.1 cents.

Unsatisfactory as the general results of the year's working are, they can be in no way attributed to any defect in the excellent work done by Mr. Baldwin and Mr. Potter. The road is simply placed in such a position that it will have to wait for the completion of the East River tunnels and the general perfection and linking up of that part of the New York transportation system. Its prosperity, in a word, must come from increased earnings, and not diminished expenses, except in so far as the proposed electrification can reduce the operating costs of passenger trains. There is every indication that the time is coming when the Long Island road may look for passanger traffic all out of proportion to that which it now carries, for it holds the key to a very large suburban territory, which will at once become readily accessible to the heart of New York on the completion of the East River tunnels, and the connecting tunnel across New York to the new Pennsylvania terminal. During the present period of incomplete development the property must meet heavy expenses without much chance either of materially reducing them or of making large gains in earnings. The best assets of the road now are its geographical position and its management.

The following statistics show some of the principal results of the year's operations:

	1904.	1903.
Mileage worked	392	392
Freight earnings	$1,923,498	$1,784,056
Passenger earnings	3,842,310	3,592,614
Express traffic	907,910	826,195
Gross earnings	6,835,848	6,440,992
Conducting transportation.	3,767,910	3,291,162
Main.-of-way and struc....	913,665	735,879
Operating expenses	5,591,971	4,787,968
Net earnings	1,243,877	1,653,024
Gross income	1,394,402	1,827,018
Net income	275,205*	305,588

*Deficit.

NEW PUBLICATIONS.

Builders' Hardware. By Henry R. Towne. New York: John Wiley & Sons. Price $3. Leather, 1,117 pages.

The author in his preface to this new handbook says very frankly that inasmuch as it

was absolutely necessary to refer many times to specific articles of builders' hardware, he availed himself of his intimate knowledge of the product of the company of which he has long been president, and while this has involved frequent reference to the Yale & Towne Manufacturing Co. the book is in no sense an advertisement or trade catalogue but a technical treatise on the subject. It is profusely illustrated with many thousand examples of hardware designs and includes an historical review of the evolution of artistic design during different periods, technical descriptions of locks and lock making, detailed lists with approximate prices of standard forms of the many articles included under the title, and a discussion of architects' specifications for hardware and finishings. One feature of special interest and value is a series of articles by W. W. Kent on the "Schools of Ornament," fully illustrated, in which the origin and characteristics of nearly all the recognized schools of architectural design are briefly discussed.

Elements of Mechanism. By Peter Scwamb, Professor of Machine Design, M. I. T., and Allyne L. Merrill, Assoc. Professor of Mechanism, M. I. T. New York: 1904. John Wiley & Sons. Cloth, 264 pages. Price $3.

The elementary principles of mechanism have been the subject of treatises and books since long before the time of Archimedes and no new book on the subject can lay claim to much originality. There are, however, different ways of presenting the subject to the student and the chief claim for consideration of this book lies in the systematic, clear and practical development of the principles and their application to mechanical movements and machines in common use. The authors' long experience as instructors has been of value in the selection and analysis of problems best suited to a short but comprehensive course. Much of the subject matter has been re-cast from notes written in 1885 and used since that time as a basis of instruction in mechanism at the Massachusetts Institute of Technology. The treatment of linkages and gear trains is especially good. As a whole, the demonstrations are simple and direct and but little knowledge of higher mathematics is required for their understanding.

Pipe, Fittings and Valves. Compiled by W. D. Browning. 79 pages, 6 in. x 9 in. Published by The Draftsman, Cleveland, Ohio. Price, bound in flexible cloth, 50 cents, and in flexible leatherette, 75 cents.

This book is liberally illustrated throughout and contains over 50 tables of dimensions pertaining to all kinds of pipe, valves and pipe fittings such as elbows, unions, flanges, railing fittings, etc. Some useful data in regards to steam coils and radiators is also given, as well as a table showing the properties of saturated steam. This book will be of interest to all who have to do with pipe work and will be of special aid to draftsmen.

TRADE CATALOGUES.

Pumps, Condensers and Water Meters.—Henry R. Worthington, New York, has just issued a 132-page catalogue bearing the title "Pumping Machinery." It is illustrated throughout with finely executed half-tones, and the apparatus described comprises all of the many types of pumping, condensing and measuring devices developed by this company in the 64 years of its existence, the most prominent being the duplex steam pump, of which Henry R. Worthington was the inventor. Special designs of this type of pump are adapted to boiler-feeding, mine-pumping, removing air and circulating water for condensers, water-works service, fire service, etc. A water-works engine of this type, without fly wheels, gave a duty of 174,000,000 foot pounds per thousand pounds of steam in a test made at the Central Park avenue pumping station at Chicago.

Air Compressors.—The Clayton Air Compressor Works, New York, is distributing a 48-page pamphlet, 6 in. x 9 in. More than 21 types of air compressors are illustrated, including single and duplex machines, steam-driven, power-driven and electrically-driven by gear, chain and belt. The last page shows two air compressors driven by direct-connected oil engines, forming small convenient units which may be installed almost anywhere and which are said to be used extensively in quarries, stone shops, small machine shops and all small plants where air is used for general purposes, such as cleaning, etc. Other pages describe the air lift, the uses of compressed air in car barns, vacuum machines for experimental work, etc. The range of sizes includes machines displacing from 2 cu. ft. of free air per minute to those having a capacity of 1,400 cu. ft.

Water Turbines and Pumps.—The I. P. Morris Company, Philadelphia, Pa., is distributing its bulletin No. 1, which describes water turbines and centrifugal pumps. It is illustrated throughout with both half-tone and line engravings of some of the largest turbine installations made by the company. Notable among these is the plant of the Niagara Falls Power Company, which is equipped with turbines aggregating 110,000 h.p. Illustrations and a detailed description of the Metairie pumping station of the New Orleans Drainage Commission are also shown. The centrifugal pump used in this station was designed and built by I. P. Morris & Co. and is claimed to be the largest centrifugal pump ever built. The diameter of the discharge is 6 ft., and the diameter of impeller 9 ft. 4 in. It has a capacity of 320 cu. ft. per sec. at a lift of 10 ft.

Cement Buildings.—The American Hydraulic Stone Company, Denver, Colo., is distributing a 48-page pamphlet. The process of manufacture of cement building blocks is described, half-tone engravings being used to illustrate the text. A view of the first building constructed under this system is shown, the Angelus Hotel of El Paso, Tex., built in 1902. Views of a large number of other buildings are also shown, including public buildings, business blocks, residences, etc., with accompanying testimonial letters and extracts from various publications in regard thereto. Retaining walls, bridge abutments and piers, dams, wide foundations and walls and other heavy construction are possible with this system, and illustrations showing methods of construction are included and described.

Wire Rope Tramways.—The Otto Wire Rope Tramway Company, Chicago, issues a catalogue which describes and illustrates the Otto system of ærial wire rope tramways. The mechanism is described in detail, with illustrations to correspond, in addition to which there are a large number of half-tone engravings from photographs of installations of the system all over the world. In the back is a folded sheet showing the profile of a ropeway built at Mazatlan, Mexico. The installation was a difficult one through rough country and involved spans up to 3,657 ft.

Industrial Bulletins.—The passenger department of the Union Pacific issues bulletins relative to the agricultural and live stock industries of the States the line traverses. Bulletins 31 to 36 (excepting 33) deal respectively with the Irish potato crop of Kansas for 1904; the Irish potato crop for Nebraska for 1904; live-stock in Nebraska for 1904; the alfalfa crop of Kansas for 1904, and Kansas livestock. The figures are tabulated by counties and are complete.

Rolling Mill Machinery.—The United Engineering & Foundry Company, Pittsburg, Pa., sends a handsome catalogue containing upwards of 200 pages, 8 in. x 10 in. Illustrations of the company's works and offices are shown on the first five pages. These are followed by illustrations of rolling mill machinery such as lever shears, punches, rail straighteners, hot and cold metal saws, roll turning lathes, hydraulic accumulators, cranes, etc.

Boring Mills.—The Gisholt Machine Company, Madison, Wis., sends its catalogue of boring mills. It is handsomely illustrated throughout and shows different sizes of vertical and horizontal boring mills made by this company. General descriptions of the above machines are given, as well as descriptions and illustrations of the Gisholt turret lathe and tool grinder.

Graphite.—The Joseph Dixon Crucible Co., Jersey City, N. J., sends its December issue of *Graphite.* As usual it is full of interesting reading pertaining to this company's product. It also contains an illustrated article by W. H. Wakeman on "Underloaded Engines." Light reading in both verse and prose is also scattered throughout its pages.

Pumps.—The Prindle Pump & Engineering Company, New York, sends its catalogue A, which describes and illustrates the Prindle standard house tank pump. This pump is driven by a direct connected motor and the tank supply is controlled by a quick-acting automatic electric switch which is actuated by a ball float and weight arm.

Rail Loader.—The United Supply & Manufacturing Co., Chicago, issues a 9 in. x 12 in. 8-page pamphlet relative to the American rail loader. The construction and operation of the device are described and three full-page half-tone views are included, two of which show the loader in operation.

Steel Furniture.—The Art Metal Construction Company, Jamestown, N. Y., sends an illustrated folder descriptive of its fireproof metallic office fixtures and furniture, including filing cabinets, tables, roll top desks, book cases, letter files, lockers, etc.

Machine Tools.—The November issue of the *Progress Reporter* published by Niles-Bement-Pond Company, New York, is being distributed. It contains a number of interesting descriptions and illustrations of tools especially adapted to railroad shop use.

Cranes.—The Northern Engineering Works, Detroit, Mich., sends its booklet No. 19. It consists of 28 pages 3½ in. x 5½ in., and contains about 26 cuts, illustrating different types of "Northern cranes."

The Passenger Agent in the Orient.

BY JOHN S. TANNER.

A short account of five years' experience in the Orient as passenger agent for one of the large transpacific steamship lines, may perhaps not be without interest to the railroad man on this side.

It may be laid down as a broad principle

that so far as his time and duties allow, the passenger agent should be in a position to give the traveling public all possible information regarding the countries, districts and towns through which their travels may take them. Owing to the great distance and also to the lack of literature on the subject, and doubtless to the fact that his time is fully occupied with his railroad duties, the passenger agent on this side has little opportunity to post himself about the Far East; passengers therefore arrive in the Orient with only a vague idea as to their future plans and with very little information as to what is to be seen and the necessary time required in the different countries to be visited.

On the other side of the Pacific, however, the passenger agent must consider it well within the scope of his duties to not only post himself on his immediate territory, but also on the many eastern countries visited by the traveler in order that he may be in a position to give accurate and detailed information to the patrons of his line. Travelers from America, landing in Japan for the first time, find themselves among a people with only a very limited knowledge of the English language. The hotel porter, a most useful man in the Far East, will assist the traveler in passing the customs and will deposit them in the "rikishas" to take them to the hotel. This first ride in one of the "human powered" automobiles is a unique experience, the feelings produced having been often described by various authors. As soon as the travelers are settled in the hotel they set forth to the office of the steamship company, by whose boat they have crossed on, the familiar sign over the door looming up like home to them.

Innumerable questions as to the curio shops, festivals, sights to be seen, hotels and sailing dates are among the many that the genial "man behind the desk" must be prepared to cheerfully answer. "Around the world" passengers want information as to connections at way ports, points of interest to be visited in China, Siam, Ceylon, India, etc.; whether the scheduled length of stay in the different ports is sufficient to enable them to visit the many famous inland towns; regarding the different climates to be met with in their travels, and probably the connecting steamer that is to take them from England back home again; cost of hotel and traveling expenses must be carefully figured out, in order that the bank account may not be unduly strained in the purchasing of curios in Japan. Perhaps the traveler is returning via Australia and New Zealand, calling, of course, at Manila, which no self-respecting American citizen will pass by without a visit; information must be at hand to satisfy these passengers.

The successful passenger agent therefore must be posted on conditions of travel in the following countries: Japan, China, Philippine Islands, Straits Settlements, Siam, Australia, New Zealand, Ceylon, Burmah; the interesting sights to be seen, and the dates of the countless festivals with ways and means of seeing them, the latter being one of the most interesting features of the Orient. The Overland route across India, with all the noted places of historical interest as the scenes of the great Indian mutiny must not be forgotten, and Egypt even may come in for some attention. As the majority of passengers leave the steamer at one of the Mediterranean ports, Brindisi, Genoa or Marseilles, particulars of these overland routes across Europe must figure as part of his knowledge. It is true, of course, that this information can be gathered en route, but the majority of passengers prefer to settle their plans as definitely as possible on their first arrival in the Orient, in order that they may advise their friends at home of their movements at the earliest opportunity, and as they feel more at ease in the office of their home steamship company, it is there that they resort for assistance and information.

With the advent of the Trans-Siberian Railway a new route was opened up for tourist travel, and while for the moment it is closed, owing to the war, when once more enabled to handle public business, it is likely to prove a keen competitor with the Suez Canal route. It is true that for scenic beauty it cannot compare with the American overland routes, at the same time it passes through an enormous, fertile territory, full of interest and novelty and with immense possibilities if properly developed. Not the least advantage this route possesses for tourists is that of a temperate climate during the summer months, thus enabling passengers to arrive in Japan during the months of April, May and June; the best time of year for a visit; proceeding on to Europe during the summer, avoiding consequently the extreme heat of the Suez Canal route.

So far reference has only been made to westbound travel from America. Eastbound we find the heaviest tourist traffic during the months of April, May, June and part of July. This consists very largely of English tourists who, leaving home in midwinter, travel through India and the tropics during the cool months, crossing the American continent during the summer. To many of these the United States is almost as strange a land as the Orient is to the American traveler, and it is to the passenger agents of the transpacific lines that they refer for detailed information of this country, in order to settle their route home and to arrange at the earliest opportunity for their accommodation on the Atlantic lines during the period of heaviest traffic on that ocean.

The passenger agent taking an interest in his work and who himself enjoys the pleasures of traveling, will find his duties in the Far East full of interest and free from that monotony so often a part of his work on this side. He comes into closer and more intimate touch with the very best class of traveling public, the majority of whom fully appreciate the interest taken in them. He must remember, however, that he is in a conservative country with the most conservative English customs, and that the traditional "rustler" necessary on this side, perhaps, is neither appreciated nor desired over there, and whilst leaving no stone unturned in striving to secure business for his line, must tune himself to the tone of the country and proceed in a quiet and gentlemanly manner in keeping with the dignity of his position, which amongst the class of people he will be brought in contact with will be far more effective. His territory is the wide, wide world; and he needs to be diligent to cover it successfully. The very great amount of attention that is now being drawn to Japan and the Far East, will without doubt at the close of the war result in a very large increase of travel across the Pacific; and it is well within reason to expect that the present tonnage—about 225,000—will be more than doubled within the next four to five years.

At the present time there are no permanently stationed passenger agents for the transpacific lines west of Hong Kong. The companies are represented by local firms in certain of the large cities, but they are not in a position as a rule to furnish very detailed information regarding this country. It seems to the writer that it might be a paying advertisement for one of the large transcontinental lines to open an information bureau in some central point like Colombo, where passengers could obtain authentic information as regards this country while at the same time it could be of assistance to them in seeing the Orient.

Problems of Heavy Electric Traction.*

BY O. S. LYFORD, JR., AND W. N. SMITH.

The Long Island Railroad has at present two passenger terminals, one at Atlantic avenue and Flatbush avenue in Brooklyn, and one at the Thirty-fourth street ferry in Long Island City, Borough of Queens. When the great tunnels of the Pennsylvania, New York & Long Island Railroad are completed there will be a third terminal for the Long Island Railroad passenger traffic in the Borough of Manhattan. From the present terminals there branches out an extensive system of through and suburban lines, over which is maintained a train service, both express and local, reaching all parts of Long Island. In addition to the suburban service at these terminals there is an interchange of traffic with the Broklyn Rapid Transit Company at two points, and a connection is to be established between the subway system of the Long Island Railroad and the extension of the Rapid Transit Subway now being built between Brooklyn and the south end of Manhattan. The accompanying map shows the location of the western lines of the Long Island Railroad and the new connections which are to be made.

Extensive plans for the electrification of the suburban service of this road have been under consideration for some years. These plans provide for the immediate adoption of electric traction on the lines running from Flatbush avenue and for a progressive extension of electric traction over all of the strictly suburban routes, as rapidly as the conditions shall justify. On some of these routes the traffic is of a purely suburban nature, providing facilities for out-of-town residents to reach Manhattan and Brooklyn. On other sections the important traffic is an excursion movement to and from New York's great playgrounds at the beaches. For the convenience of the suburban residents, a frequent service of comparatively short trains is to be provided, but for the excursion service comparatively long trains are necessary. As a result, the number of cars per train in this system will vary from one to eight or possibly ten. The initial service, limited to a maximum of six cars per train, results in 52 types of runs varying in number of cars per train and distance between stops. On some sections the lines are fairly free from grades and curves, but on others the grades and curves are heavier than would be supposed from a general knowledge of the contour of Long Island. These few statements indicate in a general way the complex nature of the problem involved in the selection of a suitable electrical system for such a service and in the determination of types and sizes of apparatus to be used. Even in a complex problem like the one under consideration, some main points may be decided by similar methods of analysis.

(a) The number of cars per train varies from one to six, as stated. Eight or ten-car trains may be desirable at times. Such variations in train length cannot be provided for economically with electrical locomotives. Motor-cars must, therefore, be used, and for all except trains of one or two cars, more than one motor car per train is necessary. The multiple-unit system of motor-car opera-

*Extracts from a paper presented to the American Institute of Electrical Engineers, Nov. 25, 1904.

tion is, therefore, best suited to this service.

(b) The greatest flexibility for make-up of trains is obtained by making all cars motor-cars.

(c) On the other hand the first cost of equipment and the cost of maintenance and inspection is least if the motor selected is of the largest size practicable, and the number of equipments required is thus made a minimum.

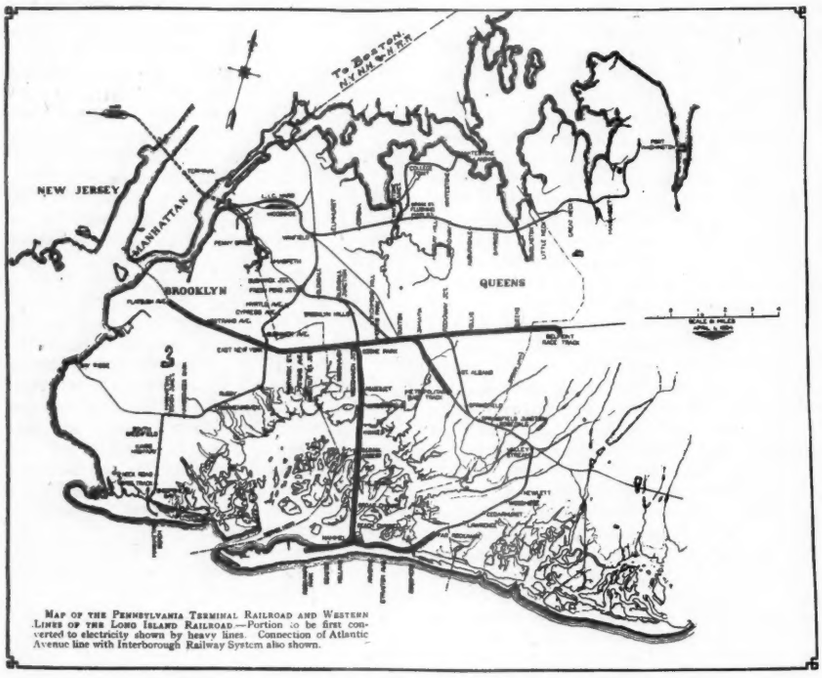
(d) For a miscellaneous service of the character contemplated, all trains, both local and express, should preferably be provided with equipment having the same speed characteristics, so that all motor cars are available for all classes of service. (Trains may operate as express in one direction and as local in the other.)

(e) For express runs of this suburban service, averaging not over five miles between stops, a moderately high speed, say 50 to 55 miles an hour, is found by experience in steam practice to be most suitable. For these runs, therefore, it is essential that the electric trains shall be able to approximate these speeds.

(f) Future development of the service, such as increase in number of stops and decrease in running time, will mean heavier work for the motors. Therefore, reasonable reserve must be provided in the equipment, and consideration must be given to equipment which will make possible a convenient increase in number of motors per train.

Size of Motors.—The largest motor in general use for motor-car trains is of 200 h.p. nominal rating, two of these being about the limit of motor capacity that can be placed on a truck with 33 or 36-in. wheels and a reasonably short wheel-base. On the basis of condition (c), this should be the motor adopted, provided the train combinations can be effected satisfactorily with motors of this size. Condition (f) is also complied with by selecting the largest motor practicable, as the number of motors per train in the initial service will then be a minimum.

Gear Ratio.—To meet condition (e), a gear ratio must be selected which permits the operation of trains at high speeds without damage to the equipment. On the other hand, the best starting conditions and least heating effect are obtained with a high gear ratio. The gear ratio should, therefore, be as high as practicable and still permit of the maximum train speeds necessary for the express schedules. Provision must also be made for extra speeds which may occur on down grades. From observation of the existing service it was concluded that it is safe to assume 60 miles an hour as a maximum.


NEW JERSEY
MANHATTAN
BROOKLYN
QUEENS
MAP OF THE PENNSYLVANIA TERMINAL RAILROAD AND WESTERN LINES OF THE LONG ISLAND RAILROAD.—Portion to be first converted to electricity shown by heavy lines. Connection of Atlantic Avenue line with Interborough Railway System also shown.

Map of Long Island Railroad Suburban District.

Train Weights.—The motor cars of the service are to be steel cars similar to those adopted for the Rapid Transit Subway. For the determination of motor characteristics, trailer cars were assumed to have the same size and weight of bodies. The weights assumed were as follows:

	Motor car.	Trailer.
Seated load	81,000 lb.	60,400 lb.
Standing load	88,000 lb.	66,000 lb.

These assumed weights are close to the actual weights of the subway equipment.

The 200-h.p. motor was found to be the proper size for the service of the subway; but the schedule conditions are so different that this in itself does not signify that the same motors are suitable for the Long Island Railroad conditions where the distance between stops for most of the local runs is greater than that of the express runs of the subway, and the express runs are longer in proportion. More or less of the usual calculating must, therefore, be done to reach a decision as to whether the characteristics of the standard motor of this size are suitable for this service or whether a smaller size could be used to advantage.

Plotted and Test Runs Compared.—The power required to overcome inertia and gravity may be calculated with exactness. Train resistance, however, made up of head resistance, mechanical friction, and skin friction, may be estimated only by empirical formulas, based on practical tests. Such formulas have been derived and published by various engineers. Owing to differences in character of equipment and road-bed, nature of the train service, design of car bodies and trucks, methods of test, etc., there are material differences in the conclusions reached. For ordinary electric car service on urban and suburban lines, where the number of stops is frequent and the maximum speed is low, the train resistance is relatively unimportant as compared with the effect of inertia and grades, but as the speed increases the train resistance becomes a more important matter. The lack of agreement of these formulas when applied to the conditions of the L. I. R. R. are illustrated in curve sheet 1. The Davis and the Baldwin Locomotive Works' formulas are extremes; they therefore afford a sufficient illustration of the divergence of authorities on this subject. These formulas are expressed as follows:

Baldwin Locomotive Works, $R = 3 + \frac{V}{6.}$

W. J. Davis, $R = 4 + 0.13\ V + \frac{.004\ A}{T} \frac{V^2}{\times [+ 0.1\ (n - 1)]}$

R = Train resistance in lbs. per ton of 2,000 lbs.
V = Velocity in miles per hour.
A = Cross sectional area of car in sq. ft.
T = Weight of train in tons of 2,000 lbs.
n = Number of cars per train.

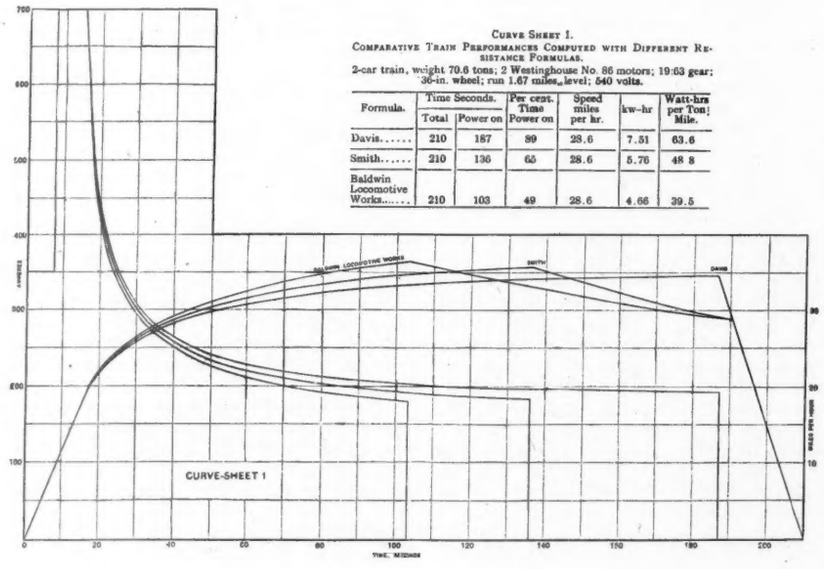
The formula marked "Smith" is one suggested by one of the authors and has been found to give results close to actual practice as will be explained in the following

CURVE SHEET 1.

COMPARATIVE TRAIN PERFORMANCES COMPUTED WITH DIFFERENT RESISTANCE FORMULAS.

2-car train, weight 70.6 tons; 2 Westinghouse No. 86 motors; 19:63 gear; 36-in. wheel; run 1.67 miles, level; 540 volts.

Formula.	Time Seconds. Total	Time Seconds. Power on	Per cent. Time Power on	Speed miles per hr.	kw-hr	Watt-hrs per Ton Mile.
Davis.....	210	187	89	28.6	7.51	63.6
Smith.....	210	136	65	28.6	5.76	48 8
Baldwin Locomotive Works.....	210	103	49	28.6	4.66	39.5



paragraphs. This formula has the following expression:

$$R = 3 + 1.67\ V + 0.0025\ \frac{A}{T}\ V^2.$$

The speed-time curves on this sheet are derived for a two-car train with cars of weight and dimensions similar to those of the New York Subway. The length of run is an average for the total Long Island suburban service. It will be noted that the power consumption (watt-hours per ton mile) varies from 39.5 to 63.6, the figure according to Davis's formula being 61 per cent. greater than the Baldwin figure. Moreover if the conditions were such that the average speed of 28.6 miles an hour between stations had to be maintained, the speed-time curve of Davis would be impracticable because of no allowance in coasting to provide for possible delays, etc. Therefore, whereas the Baldwin formula indicates a satisfactory equipment working with very low power consumption, the Davis formula for the same equipment shows, relatively, a very high power consumption and an impracticable equipment. The necessity of careful investigation of this matter in connection with the problem is apparent.

TABLE 1.—AVERAGE SPEED AND WATT-HOURS PER TON-MILE.

(Comparison of Theoretical Results with Actual Tests.)

	G. R. G. H. & M. Ry. (Schedule speed the same.)				D. Y. A. A. & J. Ry. (Schedule speed the same)			Arnold & Potter Tests. (Power cut off same distance from start. Schedule speed not the same.)			
Test number	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Weight of train, tons	29.5	29.5	29.5	29.5	32	32	32	228.5	201.5	175.5	148.5
Davis, miles per hour	27.9	32.7	30.4	30.4	28.3	31.5	33.4	26.6	27.7	29.2	29.6
" watt-hrs. per ton-mile.	98.0	99.2	85.7	115.1	99.0	102.0	95.0	87.0	98.5	102.0	111.0
Smith, miles per hour	27.9	32.7	30.4	30.6	28.3	31.5	33.4	27.6	28.4	30.9	30.6
" watt-hrs. per ton-mile.	79.2	81.6	75.0	111.5	94.0	96.0	89.0	72.0	84.5	84.0	89.5
Test, miles per hour	27.9	32.7	30.4	30.6	28.3	31.5	33.4	27.1	28.4	29.9	30.6
" watt-hours per ton-mile.	88.2	81.0	86.2	110.0	99.0	105.0	97.0	79.4	82.0	86.9	93.4
Motors	Two No. 50-C.				Four No. 76.			Eight Gen. Elec. No. 55.			

Application of Formulas.—The essential points to be determined are the schedule speeds which can be obtained with given equipments, the power that will be required to obtain these speeds, and the heating effect on the motors. The value of train resistance is best determined at full speed, or while coasting; but except in the case of long runs most of the power is consumed in accelerating. By comparing actual test runs with plotted runs from start to stop, we get some check on the train resistance formulas, but, what is of more immediate importance, we get a verification of the accuracy of all the elements entering into our calculations.

To effect a comparison of theoretical results with actual tests, some special tests were made on the Grand Rapids, Grand Haven & Muskegon Railway, and on the Detroit, Ypsilanti, Ann Arbor & Jackson Railway in Michigan. These tests were necessarily confined to trains of one car each. The tests reported by Messrs. Arnold and Potter, made at Schenectady, were on trains of greater lengths. To supplement the single-car data of trains of identical composition and equipment, theoretical runs were plotted for comparison with some of these Schenectady tests. The various comparisons made are summarized in Table 1, which, therefore, shows the comparison of theoretical and actual results for trains of from one to eight cars.

On the G. R., G. H. & M. the equipment consists of two 150-h.p. motors mounted on a heavy Baldwin truck with Gibbs suspension. The non-motor truck is also of the Baldwin make and the entire equipment is of the highest standard. On the D., Y., A. A. & J. the equipment consists of four 75-h.p. motors mounted on rather light trucks.

For comparison with these actual results, theoretical runs were plotted in which the length of run was made the same, the average speed was made the same where possible, and the average rate of braking was assumed to be the same as in the actual experiments. The curves were corrected for pressure and grade so as to conform as closely as possible to the conditions prevailing during the test.

The acceleration curve from the Davis formula conforms more closely to the tests for the D., Y., A. A. & J. car, but for the G. R., G. H. & M. car and for the Arnold and Potter trains it falls below the actual curve, in some cases to such an extent that the theoretical schedule speed is below the actual, even with coasting eliminated. The Smith formula gives accelerations practically coincident with the G. R., G. H. & M. tests and somewhat higher than the actual for the other tests, the difference in any case not being sufficient to be misleading in the results as to schedule speed. This difference may easily be accounted for by difference in pressure or inaccuracies in observation of instruments. In the case of the D., Y., A. A. & J. car the type of trucks and the drops in pressure may have caused the reduced acceleration. In the case of the Arnold and Potter tests the most decisive point in the comparison is the fact that, under the prescribed condition of cutting off power at the same distance from the start and making the same length of runs in the same time, to follow the Davis formula would not only necessitate the elimination of coasting but would require braking at a practically impossible rate. In other words, if the Davis formula be correct the trains could not have made the runs in the time that they actually did make. The conclusion, therefore, is that the Smith formula most nearly represents the actual train resistance for all of these tests.

With reference to power required, the actual results appear to fall between the results obtained with either of the two formulas. The calculations based on the Smith formula are closer to the actual results in most cases. For the G. R., G. H. & M. car, where the acceleration curves agree, the watt-hours per ton mile are also very close, and in the Arnold and Potter tests even with a reduced schedule speed the watt-hours per ton-mile are considerably greater for the Davis formula than for the observed tests. The conclusion reached is that the Smith formula affords a better basis for calculating the average speeds, and is sufficiently close for the determination of power required.

Test of Equipment Similar to that Proposed for the Long Island Railroad.

Through the courtesy of the Interborough Rapid Transit Company and Westinghouse Electric & Manufacturing Company it is possible to present the record of a special test which has a direct bearing on this subject, because the type of motor equipment used in the test is the same electrically as that recommended for the L. I. R. R. project. On Jan. 30, 1903, a test was made on the Ninth avenue line of the Manhattan Elevated, of the sample motors submitted by the Westinghouse Electric & Manufacturing Company as representing the motors which that company was to furnish to the Interborough Rapid Transit Company. In these tests the train weight corresponded closely with the weight per motor of the equipment proposed for the L. I. R. R. and the motors were of the same size and general characteristics. The length of the test run was too short to permit the cars to reach maximum speed; as the value of train resistance is best determined at maximum speed, this test cannot by itself be considered an absolute check on calculated curves. The conclusions derived from this tests, however are as follows:

(a) The motor control did not permit of the rapid application of power assumed in the calculations, time being lost in going from series to parallel. This, however, did not affect the results adversely.

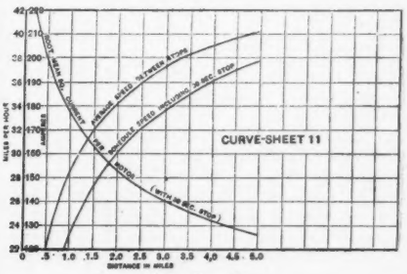
(b) At the maximum speed when current was on, namely, 26 to 28 miles per hour, the theoretical curve shows practically the same energy consumption as the test. This indicates that the train resistance was practically as calculated. For corresponding speed on the motor curve, the power required according to theory is in both cases slightly higher than the power required according to test; this indicates that the Smith formula gives a train resistance which is slightly higher than the actual resistance for this equipment. The Davis formula, giving higher values than Smith would give results still farther from the actual conditions.

(c) The calculations for energy consumption and square root of mean square current give results slightly higher than the test.

(d) The theoretical methods, therefore, give values which are slightly on the safe side for short runs.

(e) The tests do not afford direct evidence of the accuracy of the theoretical methods when applied to longer runs with higher speeds, but the indications are that for such runs the theoretical values will also be on the safe side and close enough for all practical purposes.

Use of Typical Run Curves.—As previously stated, the proposed electrical schedule for the Long Island Railroad provides for a large number of combinations of weights of trains and lengths of run. It is obvious that a tremendous amount of time would be consumed if an attempt were made to plot each of these runs and to make the determinations of schedule speed, power consumption, and heating effect for the various types and sizes of motors which might be used. To avoid this expenditure of time it was necessary to adopt certain approximate methods, and one method which was used after verification by a practical comparison is what may be called the "Typical Run Curve."



CURVE SHEET 11.

GENERAL PERFORMANCE CURVE.

3-car train for L. I. R.R.; two 44-ton motor cars; one 33-ton trailer car; total weight 121 tons; four No. 86 Westinghouse motors; 23:59 gear ratio; 36-in. wheel; 540 volts; 1.5 miles per hr. per sec. braking; no coasting.

Disregarding grades and curves, a single run for a distance equal to the average length between stops will represent the conditions pertaining to a through run; by plotting results for such average runs of differ-

ent lengths, curves are obtained which will give exact results for the actual conditions assumed and approximate results for the varying distances between stops and on a succession of light grades and curves. Curve sheet 11 illustrates the character of the curves obtained in this way.

The principal question involved as to the propriety of such a typical run curve is whether the result so obtained (by considering the track straight and level and the distance between all stops the same) will agree closely enough with the average of results obtained from plotting the time-speed curves of an entire round trip, taking the grades and curves into account and placing the stops exactly. It would seem reasonable that the effects of grades in one direction should balance those in the opposite direction when calculating the general results of a run plotted for a round trip when the time of a single run is not greater than one hour, as in this case. If the results of train runs plotted complete be compared with typical run curve results, and if this comparison is generally favorable under varying conditions of grade and length of run, it is safe to assume that typical run curves can be used in place of plotted runs for purposes of general estimate and comparison of different types of equipment when operated under similar conditions. The comparisons have, therefore, been made for a given equipment by making plotted runs in opposite directions over the same grades on certain routes of the Long Island R. R. both on the comparatively level runs of the Manhattan Beach and Rockaway Beach divisions and on the more hilly runs from Long Island City to Port Washington.

These runs were calculated for the purpose of comparing the determination of square root of mean square current. It is possible to make similar comparisons for kilowatt-hours per car-mile and watt-hours per ton-mile, but it is safe to assume that a check made on the comparative determinations for square root of mean square current will indicate the correctness of the assumptions for the determination of the other requirements.

In general it will be noted that the differences between typical run results and the plotted runs, even in the case of the North Side Division, on which conditions of grade are most severe, do not exceed 5 per cent. for the square root of mean square current and about 4 per cent. for speed. For preliminary determinations of motor characteristics, reasonably close results are obtained by this method, except possibly where very unusual conditions exist. No claim is made that the method is new; in fact, it is quite generally used. The data given simply shows that under ordinary circumstances it is reasonable to use this short method and thus dispense with a vast amount of tedious calculating.

Schedule Speed Requirements and Limitations.—The operating conditions of a steam railroad introduce limitations which cut down the possible speed of the motive power equipment. Many of these are conditions over which the engineman has no control and which do not relate to the nature of the equipment; that is, curves, road crossings, junction points, yard limitations, meeting points on single track lines, time to handle baggage and express matter, etc. There are delays at stations and delays during runs, some of which occur regularly, but many of which are intermittent. Because of the complicated service these delays are greater on the suburban lines of a steam road than usually occur in interurban or elevated electric service. It is, therefore, evident that in the electrical operation of such suburban service the loading of the motors will differ materially from the loading in an ideal run which might be made with the conditions removed.

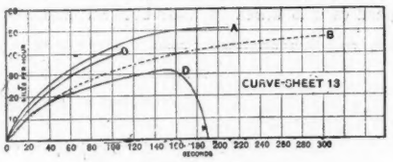
After considering various methods of providing for these conditions it was decided to make a series of tests of the present steam equipment to determine the speed-time characteristics of the steam trains and the degree to which these characteristics are affected by the local conditions. To this end a test car was equipped with a speed-recording device and runs were made over various routes with this car attached to regular trains. Complete records were obtained of the movement of each train throughout a round trip, and observations made of local conditions which affect speed. These records were carefully analyzed and the results tabulated. In some instances the engineers were requested to make the best time possible; in other cases they were not advised that a test was in progress.

In summarizing these test runs comparisons were made between the average speed between stops as actually attained and the possible average speed if best acceleration had been made for each run. The character of record obtained is illustrated in Tables 2 and 3. It was found that the ratio of the actual speed to the possible speed without local limitations is from 71 to 91.3 per cent. Even when the engineers were requested to do their best they were able in only one or two instances to exceed 90 per cent. of the speed which appeared to be possible from the test. On runs 335 and 346 of the Whitestone Division, in which locomotive No. 59 made the best single record, the average speed for the run was also nearest to the maximum limit.

From these records the four best single accelerations were selected. Curve sheet 13 shows the speed time characteristics of these accelerations. Curve D illustrates the general character of record made by the instrument in these tests. This run, having been made on a level, conforms exactly with the record obtained. Curves A, B and C were obtained on grades, and the actual record has been corrected to illustrate the performance of these trains when reduced to a level. In each case the average acceleration over the run was less than the characteristic shows, but these curves illustrate the maximum that the steam equipment was able to do. The composition of trains and their estimated weights are indicated on the curve sheet. The live load on these runs was so light that it was disregarded. On curve sheet 14 will be found two curves (E and F) of actual runs on grades compared with run A of the curve sheet 13. According to curve E, a five-car train on a down grade was accelerated at a rate far below the best performance and even the three-car train with locomotive No. 35 (curve F) was not accelerated on a down grade with a rate any better than the best single performance on a level.

It will be noted that the curve *A* was made by a locomotive whose weight was 51.5 per cent. of the total weight of train. The officers of the railroad company were of the opinion that service equivalent to that which could be performed by this locomotive, No. 59, with only three cars would be a sufficient for the electric equipment. The best performance of this locomotive was, therefore, taken as the criterion by which to work in determining the proper characteristics for the electric equipment. The condition laid down was that the electrical equipment, operating a train with standing load in the cars, should be able to make the same average speed between stops as this particular steam equipment.

Taking curve A as a basis, determinations were made of what may be termed the "speed limit" for steam trains. This is a curve in-



CURVE SHEET 13.

TIME-SPEED CURVE OF 3-CAR STEAM TRAIN.

A.—From best locomotive performance reduced to level. Weight of train, including locomotive No. 59, 171.9 tons disregarding light live load. Weight of locomotive, including tender, 88.5 tons. Weight on drivers, 37.5 tons.

TIME-SPEED CURVE OF 5-CAR STEAM TRAIN.

B.—From best locomotive performance reduced to level. Weight of train, including locomotive No. 64, 232.6 tons disregarding light live load.

TIME-SPEED CURVE OF 3-CAR STEAM TRAIN.

C.—From actual run made on a level. Weight of train, including locomotive No. 72, 175.1 tons, disregarding light live load.

TIME-SPEED CURVE OF 5-CAR STEAM TRAIN.

D.—From actual run made on a level. Weight of train, including locomotive, No. 64, 232.6 tons disregarding light live load.

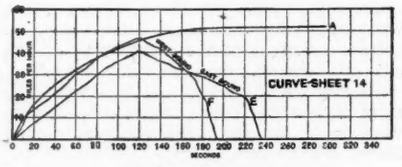
TABLES 2 AND 3.—LONG ISLAND RAILROAD.

Table 2. Long Island City to Valley Stream via Far Rockaway (Eastbound). Length of run, 22.97 miles.

Train No.	1287.	1303.	1321.	Average.
Locomotive number	72	34	.....	.....
Locomotive weight	179,000	154,500	.....	.....
Number of cars	3	6	5	4
Total weight of train, tons	175.1	186.55	.....	.....
Schedule time of run	56:00	55:00	58:00	56:00
Actual time of run	52:30	74:20	59:00	62:00
Schedule number of stops	9	10	12	10
Actual number of stops	10	11	12	11
Maximum acceleration	0.6	0.7	0.65	0.65
Grade on which made	—1.00	—0.08	—0.08	—0.38
Maximum retardation	1.6	1.8	1.9	1.76
Grade on which made	Level.	Level.	Level.	Level.
Average acceleration	0.47	0.46	0.35	0.426
Average retardation	1.04	1.06	1.22	1.11
Maximum speed	56.5	52.5	50.0	53.0
Average length of run	2.08	1.91	1.77	1.92
Average time of run	4:03	4:48	4:10	4:20
Average maximum speed	39.9	34.8	33.5	36.1
Length of longest run	7.77	.....	.....	.....
Time of longest run	11:20	.....	.....	.....
Average time of stops	0:49	1.55	0:25	0:63
Average speed between stops	30.8	23.9	25.5	26.5
Possible average speed from curve.	34.5	33.7	32.7	33.8
Ratio av. to possible av. speed, %.	89.4	71.0	76.0	78.5

Table 3. Whitestone Division (Westbound). Length of run, 11.75 miles.

Train No.	346.	360.	318.	Average
Locomotive number	59	35	20	.....
Locomotive weight	177,000	154,500	139,500	.....
Number of cars	3	3	5	4
Total weight of train, tons	171.9	162.85	217.85	184.2
Schedule time of run	28:00	28:00	31:00	29:00
Actual time of run	28:34	27:34	35:15	30:27
Schedule number of stops	7	7	7	7
Actual number of stops	7	7	7	7
Maximum acceleration	0.9	0.95	0.5	0.78
Grade on which made	—0.65	—0.65	—0.75	—0.68
Maximum retardation	1.8	2.0	1.9	1.9
Grade on which made	1.07	0.69	1.28	1.01
Average acceleration	0.44	0.35	0.29	0.36
Average retardation	1.43	1.5	1.2	1.38
Maximum speed	52.0	50.0	44.5	48.8
Average length of run	1.47	1.47	1.47	1.47
Average time of run	3:08	3:14	3:55	3:26
Average maximum speed	41.0	38.3	33.5	37.6
Length of longest run	.....	.....	1:63	.....
Time of longest run	.....	.....	3:47	.....
Average time of stops	0:29	0:15	0:33	0:26
Average speed between stops	28.1	27.3	22.5	25.9
Possible average speed from curve.	30.8	30.8	30.8	30.8
Ratio av. to possible av. speed, %.	91.3	88.6	73.0	84.2



CURVE SHEET 14.

TIME-SPEED CURVE OF 3-CAR STEAM TRAIN

A.—Taken from curve sheet No. 13.

TIME-SPEED CURVE OF 5-CAR STEAM TRAIN

E.—From College Point to Whitestone, made by 5-car steam train Weight, including locomotive No. 18, 276.1 tons disregarding small live oad. Acceleration made on average grade of —0.78 per cent.

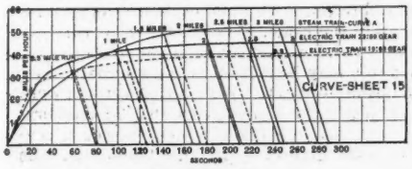
TIME-SPEED CURVE OF 3-CAR STEAM TRAIN.

F.—From Whitestone to College Point, made by 3-car steam train Weight, including locomotive No. 35, 162.85 tons, disregarding small live load. Acceleration made on average grade of —0.74 per cent.

dicating the average speed in miles per hour between stops with the rate of acceleration corresponding to curve A, without coasting; and with a braking rate of 1.5 miles per hour per second. On curve sheet 16 there will be found a characteristic speed-time curve of this steam train making runs of from one mile to three miles. From this curve the speed-limit curve No. 17 was plotted. Table No. 4 shows how this speed-limit of steam trains compares with the average speed between stops required to make various typical runs of the proposed suburban service. It will be noted that the average speed of the schedule runs is from 71.2 per cent. to 92 per cent. of the speed limit, with about 80 per cent. as a mean figure.

SCHEDULE CONDITIONS OF PROPOSED ELECTRIC SERVICE.

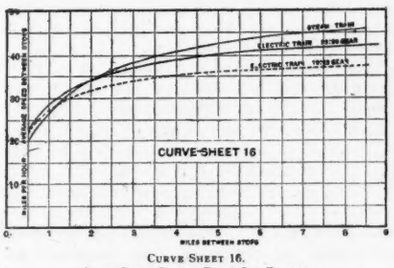
Obviously, to make the same time, the speed characteristics of the electric equipment selected for this service must be such that the schedule can be maintained with similar speed reserve, unless the limiting conditions are removed. Elimination of grade crossings at roads and junction points, handling of baggage and express matter by special trains, improvement of yard facilities, etc., will make it possible to operate trains at speeds closer to the limit of the equipment. On the other hand, as the population along the road increases the tendency will be to increase the number of stops with as little increase in the running time as possible; therefore it was decided not to make any material allowance for improved conditions in the initial service. The probability of such improvement, however, suggests another precaution to be taken in the selection of equipment; namely, the provision of a suitable reserve in the capacity of the motors to carry the greater loads which will result from running at speeds closer to the limit.



CURVE SHEET 15.
TIME-SPEED CURVE OF STEAM TRAIN
Curve *A* of sheet No. 13.
TIME-SPEED CURVES OF PROPOSED ELECTRIC TRAINS.
Best possible performance on level grade.
Weight of train, 121 tons, without standing load.
(All 3-car trains.)

On curve sheet 15 are shown time-speed curves of a three-car electric train with two motor cars and one trailer, with standing load in the cars, which curves may be compared with the corresponding curve of the steam train shown on the same sheet. It will be noted that the electric equipment with the low gear ratio has a maximum speed on straight level track of approximately 45 miles an hour, and with the high gear ratio, 39 miles an hour; whereas the limit of the steam train on the level is 52 miles an hour. For a run of one mile or less between stations, however, the electric train with either the high or the low gear ratio makes better time than the steam train. For a run 1.5 miles long the electric train with high gear ratio falls behind the steam train, and at slightly over two miles the electric train with the lower gear ratio falls behind.

The comparative speeds of these trains are still better illustrated on the speed-limit curves of curve sheet No. 16. The general average length of run between stops for the suburban service is about 1⅞ miles. It is evident from the speed-limit curves on curve sheet 16 that a three-car electric train with two motor cars and gear ratio 23:59 will average slightly better as to speed than the three-car steam train, but that the same equipment with higher gear ratio falls considerably below the speed limit of the steam train. From this exhibit it is obvious that schedule requirements indicate that no gear ratio lower than 23:59 should be adopted.



CURVE SHEET 16.
SPEED LIMIT CURVES FOR 3-CAR TRAINS
Showing best possible speed between stops over various lengths of run, without coasting.
Steam train based on curve *A* for acceleration
Electric train with standing load weighs 121 tons.

It is also evident from these speed-limit curves that if 23:59 is the lowest gear ratio practicable as determined by the limitations, the three-car train unit will have to be made up of two motor cars and one trailer, in order that the requisite speeds may be reached. The weight per motor for this equipment is 30.3 tons, which on this basis of speed requirements is obviously close to the limit. To determine what equipment will be necessary for a two-car train, the speed-limit curves of curve sheet 17 have been prepared. In this case the two-car train is made up of one motor car and one trailer. It will be noted that such an electric train, with standing load, falls below the speed limit of the steam train at slightly over one mile between stops. As regards speed requirements, therefore, the two-car train with motor car and trailer has not sufficient motor capacity, and except in cases where speed limitations are slight, two-car trains will have to be made up of two motor cars in order to make the schedule. On this curve sheet, No. 17, the corresponding curve for train with seated load has been plotted to indicate the difference in schedule speed possible during the light traffic hours of the day, as compared with the hours of heavy load in the morning and evening. It will be noted that in the case of heavy equipment of this character, the changes in weight of live load do not materially affect the speed characteristics of the equipment.

Attention should be called to the column in Table 6 showing the ratio between the average speed of steam train between stops on different runs according to schedule, and the speed-limit possible with the best steam train in each case. Another column of this table gives the ratio of average speed to the speed-limit of the three-car electric train for the same runs. The reserve speed in the electrical equipment corresponds closely with the reserve in the steam equipment throughout the list. It, therefore, seems evident that this three-car train unit fulfils the requirements laid down as to speed, and can be depended upon to make the required schedule with standing load in the cars, allowing for all the delays contemplated in the present schedule for steam equipment.

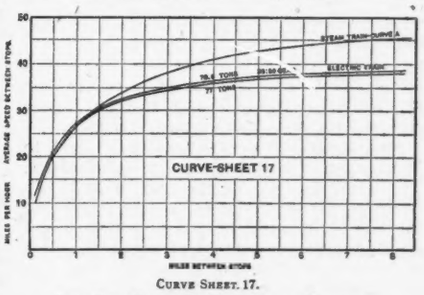
TABLE 6.
DATA FOR SUBURBAN RUNS. L. I. R.R.
OMITTING RUNS WHERE NUMBER OF STOPS IS SAME AS HEREIN BUT TIME AT STOPS IS LESS.

Run.	Distance miles.	Time minutes.	Train sheet schedule speed entire run.	Intermediate No. of stops per trip.	Time out for stops.	Average Length of Run miles.	Time of average Run minutes.	*A.* Average speed between stops miles pr hr	*B.* Limit av. speed best steam train miles pr hr	Ratio of *A.* / *B.* steam.	*C* Limit average speed electric train 23:59 gear ratio.	Ratio *A* / *C* Electric.
Long Island City. Fort Washington.	18 18	41.5 43.0	26.3 25.4	7 8	4.5 5.0	2.27 2.02	4.62 4.22	29.5 28.7	36.0 34.0	81 9 84 4	35.5 34.0	83.2 84.5
Long Island City. Whitestone Landing.	11.75	31.0	22.8	7	3.5	1 47	3.44	25.6	30.8	83.2	31.8	80 5
Long Island City Rockaway Park.	16.2	39.25 39.0 40.0 41.0 43.0 43.75 47.0	24.9 25 1 24.4 23.8 22.8 22.3 20.8	5 6 7 8 10 11 14	2.5 2.75 3.5 4.25 4.0 4.5 5.5	2.72 2.33 2.04 1.81 1.48 1.36 1.09	6.12 5.18 4.57 4.08 3.55 3.27 2.76	26.7 27.0 26.8 26.6 25.0 25.0 23.7	37.5 36.0 34.0 33.0 30.8 30.0 27.0	71.2 75.0 78.8 78.8 81.2 83.3 88.0	36.5 35.5 34.0 33.5 31.8 31.0 29.0	73.2 76.1 78.8 79.5 78 7 80.7 81 8
Long Island City. Valley Stream.	22.97	59.5	23.1	11	7.5	1.91	4.33	26.4	33.7	78.4	33.7	78 3
Long Island City Manhattan Beach	16.1	37.0 38.0 40.0 44.0	26.1 25.4 24.2 22.0	3 4 5 11	2.0 2.5 3.75 6.5	4.03 3.22 2.68 1.34	8.5 7.1 5.87 3.12	28.5 27.2 27.4 25.8	41.0 39.0 37.5 29.8	69.5 69.8 73.2 86.5	39.0 37.5 36.5 31.3	73.0 72.6 75.0 82.5
Flatbush. Rockaway Park.	15.88	39.5 44.75 45.5 47.0 48.0	24.5 21.5 20.9 20.2 19.8	7 11 12 13 16	4.0 5.0 5.75 6.5 6.75	1.98 1.32 1.22 0.99 0.93	4.56 3.31 3.06 2.53 2.43	26.0 23.9 23.9 23.5 23.0	34.0 29.5 28.5 26 5 26.0	76.5 81.2 84.0 88.6 88.5	34.0 31.0 30.0 28.5 28.0	76.5 77.2 79.6 82.5 82.2
Flatbush. Jamaica.	9 63	19.0 23 0	30.4 25.1	1 5	1.0 3.0	4.81 1.61	9.0 3.33	32.0 29.0	42.5 31.5	75.3 92.1	40.0 32.5	80.0 89.2
Flatbush. Valley Stream.	22 55	60 5	22 4	13	9.0	1 61	3 68	26.1	31.8	82 0	32.0	82 4

It is obvious that trains made up into combinations of motor-cars and trailers that give less weight per motor will be able to make better speeds than indicated for this three-car train. Furthermore, as the number of cars per train increases, the relative effect of head resistance decreases. For these longer trains it is, therefore, possible that a greater proportion of trailer cars may be used in some instances without reducing the speed-limit to such an extent as to prevent the train from making schedule time.

It is not the purpose of this paper to follow out all the technical processes by which final conclusions were deduced as to size and characteristics of motor equipments for the project referred to. Sufficient illustrations have been given to show:

First, that a study of the operating conditions of even a complex project quickly narrows the selection of motors down to one or two sizes, and that these conditions also largely determine the speed characteristics of the equipment; *second*, that theoretical methods are now developed to a point of sufficient accuracy to be considered reliable for purposes of selecting equipment; *third*, that short methods may be used with discrimination, at least for preliminary determinations.



CURVE SHEET. 17.
SPEED LIMIT CURVES FOR MOTOR CAR AND TRAILER
Compared with steam train.
Electric train weighs 70.6 tons, seated load.
Electric train weighs 77 tons, standing load.
Steam train based on curve *A* for acceleration.

Testing Steam Boilers.*

The accepted method of conducting tests of steam-generating apparatus determines the results of the performance of the combined apparatus and its manipulation. Such experiments are referred to as "boiler" tests, yet they are not properly tests of the boiler, nor do such experiments show the results of the performance of the fire or the furnace feature, except as measured through a more or less inefficient boiler. Basing results on the coal supplied to the grate less that which goes to the ash pit or is removed from the fire in cleaning, is a step toward determining the efficiency of the boiler, but, with present methods, it is assumed that the effect of the fire is constant or uniform, although gas analysis is required which shows that fires differ in quality, but this fact is neglected in considering the efficiency of the boiler, yet any performance is dependent on the condition of combustion, or, in other words, the temperature of the fire.

The purpose of the boiler is to receive heat from the gases, which is supplied to them by the process of combustion. As heat only flows from a region of higher to one of lower temperature, and as its rate of flow is governed by the difference between the temperatures, it necessarily follows that most heat will flow to the boiler when its temperature is highest. It is useful in this connection to consider that heat and temperature are two entirely different things, temperature being the condition under which the heat is present. If a given quantity of heat is contained in a large amount of gas, it will be at a low temperature, but if in a small amount, it will be present at high temperature. That this is true may be determined according to the formula,

$$\text{Temperature} = \frac{\text{Heat developed}}{\text{Weight of gas} \times \text{its specific heat.}}$$

Thus the performance of a boiler is influenced by the temperature at which the heat is supplied; also, when a large quantity of heat is furnished, its absorption is less complete than with a small quantity, the temperature being the same in each case. Therefore, if boilers are to be compared with each other, so their heat efficiency can be determined, it could be accomplished if supplied with the same relative quantity of heat at the same temperature. These conditions would be fulfilled if a uniform number of heat units be supplied for each square foot of heating surface per unit of time and at some accepted standard temperature.

Gaging the required quantity of heat to be supplied would present several difficulties. The heating power of the fuel could be determined by sampling an analysis previous to instead of after the test, which would enable the proper amount of heat in the coal to be furnished to the grate, but fuel lost in the ash-pit, removed in cleaning the fire or carried over the bridge wall, and incomplete combustion, would have a varying influence on the quantity of heat generated, and the percentage of such heat, undeveloped, must be known and provided for in the supply of the fuel to the grate. The use of a standard high-grade coal would, of course, very largely reduce these difficulties.

As different steam pressures have an influence on the amount of heat flowing to a boiler, it would be necessary to use some standard pressure, which need not be that which would be employed in service. And the loss of heat by radiation would be determined or not, as circumstances require, but with well-set apparatus it could be assumed to be constant at rated capacity.

*Abstract from a paper by A. Bement read before the American Society of Mechanical Engineers, December, 1904.

The supply of a certain predetermined amount of heat would be a very difficult matter, and a less efficient boiler would absorb a smaller quantity of heat than a more efficient one, although the same quantity be supplied per unit of surface and time, and at the same temperature, therefore, the less efficient boiler would do less work. Thus the capacity would not be the same for each, and instead of there being simply a difference in efficiency there would be a difference in both efficiency and capacity. It would probably be better to produce a uniform capacity as measured in equivalent pounds of water evaporated from and at 212 deg. per square foot of heating surface per hour, or, in other words, operate the boiler at its rated horse-power capacity. This would be a simpler method than that of affecting uniform supply of heat, and a standard condition of combustion as shown by the gas analysis would insure that the heat be developed at the required temperature. Owing, however, to slight varying composition of fuels, it would be desirable to use coals in which the ratio between carbon and hydrogen is approximately the same. Thus with standard conditions of developed capacity, initial temperature and steam pressure, the heat developed referred to the heat absorbed, will show the efficiency of the boiler, so that comparisons may be made.

The efficiency of any particular boiler is a fixed quantity, which once ascertained according to some standard applies to any number of reproductions, and thus need only be determined once. It does not follow, however, that the efficiency of different sizes of the same kind of boiler is the same. For example, there is a horizontal water tube type which is usually made from 9 to 14 tubes in height, the travel of the gases being three times across the tubes. The higher boilers are more efficient than the lower ones. For the reason that the gases pass across the tubes at a volume dependent on their temperature, and as the temperature drops, the volume becomes less, which results in a portion of the tube surface of the second and third passes especially not being in the path of the flowing gases, therefore the fixed path of the gases passes across 27 tubes in the boiler which is nine tubes high, and across 42 tubes in the one which is 14 tubes high.

Purchasers' requirements will demand in the future as in the past that tests of the combined apparatus with the fuel to be used be made to demonstrate if a certain efficiency and capacity are obtainable. The results of such tests, however, are confusing when an attempt is made to determine the efficiency of boilers or of any portion of the apparatus. It is the author's opinion that there is a greater difference in the efficiency of different boilers than is generally realized. In this connection, experiments on two boilers to determine their relative efficiency may be of value.

These boilers of a horizontal water tube type adjoined each other in one battery. With each the gases were discharged to the same flue and steam at 175 lbs. pressure to the same steam header. A chain grate stoker was located under each, and the furnace feature of the apparatus was well developed by fire brick tile suspended from the bottom tubes of the boiler, which extends approximately 12 ft. back from the front, corresponding to a brick arch of that length, in addition to the ignition arch of the stoker. These boilers are designated as *A* and *B*, and they and their associated features are exactly the same, except that of the path of travel of the gases among the tubes. With *A* the gases travel with the length of the tubes once and do not act on all of the tube surfaces. With *B* the travel is three times the length of the tubes, in separate passages, which caused the gases to come in contact with very much more of the tube surface than with the boiler *A*. Table No. 1 gives the relative final temperatures of escaping

Table No. 1.

	Boilers A	Boilers B
Condition of combustion, CO_2	10.7	10.3
Horse-power developed	564.3	580.4
Heating surface, sq. ft.	4,800	4,800
Temperature of escaping gases:		
Final	657	469
Above air supply	582	394
Above steam temperature	278	93
Greater than B.	186	...
Temperature of steam	379	377

gases at approximately the same capacity and condition of combustion. These experiments were not made at the same time, but the same kind of coal was used. The reason that the gas analysis was only carried to CO_2 is that, owing to the very efficient tile roof furnace, combustion was always complete. The horse-power developed placed each boiler nearly on the same basis, being about 3 per cent. to the disadvantage of *B*, therefore the work done by each was approximately the same. The condition of combustion was also slightly in favor of boiler *A*, but this may be considered as approximately the same for each. Thus all conditions were practically the same except that of temperature of escaping gases, which showed a considerable difference in the boilers as gas coolers.

If the specific heat of gases at high temperature were known, the gas analysis and an ultimate analysis of the fuel would afford data for calculating the quantity of heat in a pound of gas at initial temperature, and the heat remaining at final temperature could be calculated from direct temperature measurement, and the efficiency could be expressed according to the equation,

$$E = \frac{H_1 - H_2}{H_1},$$

and it would not be necessary to determine the quantity of fuel used in such an experiment as given in Table No. 1.

If the reduction in temperature of escaping gases from a boiler at 186 deg. may be taken as representing the work of an average economizer, then it appears boiler *B* possesses an efficiency equal to that of the combined efficiency of boiler *A* and an economizer; or, in other words, that *B* is as efficient without an economizer as the combined efficiency of boiler *A* with one, which serves to illustrate the great difference which may exist in different boilers.

These boilers were also tested by the alternate method of the standard code, which was feasible, because conditions could be exactly the same, and the object was to compare one with the other, and not with boilers in general. The tests were run at the same time, one being started 15 minutes before the other. Alternate wheelbarrows of coal from the same source were laid down before each boiler only as required. The thickness of the fire was the same. Each damper was full open and the speed of the stoker regulated so that the fuel bed extended to the end of the grate. The result is shown in Table No. 2.

Table No. 2.

	Boilers A.	Boilers B.
Pounds pure coal burned per hr.	1,765.75	1,446.56
" water evap. per hour.	13,210.34	13,629.24
" water evaporated per lb of pure coal burned	7.47	9.42
Htg power, pure coal, B.T.U., lb.	13,633	13,633
Temperature:		
Feed water	212	212
Gases, final.	594	442
" above air supply	514	362
" above steam tempertre	217	65
" greater than B.	152	...
Saturated steam	377	377
Draft over fire, inches of water.	0.38	0.22
Horse-power	383	395
Efficiency, per cent. of heat absorbed by boiler	52.93	66.73
Fuel saving of boiler B over A, per cent.	...	20.68

Pure coal is an expression which the

author prefers to use instead of that of combustible, because the fuel free from ash and moisture contains oxygen and nitrogen, which are not combustibles. The capacities were lower than those in Table No. 1, because the coal used was a less favorable size. This latter test shows the effect of the difference in efficiency of the two boilers in ordinary service.

The author prefers to recognize a steam generating apparatus as being composed of separate features as follows: As boiler and grate, with this combination, the gases flow in contact with the heating surface immediately as they leave the fire. Also, as boiler, grate and furnace, the latter feature consisting of a refractory roof over the fire which extends back a considerable distance, its presence making it possible for the gases to be mixed together a sufficient extent while at high temperature, so that no combustible escapes oxidation. Such feature here designated as a furnace, if of a length of about 14 ft., will produce an ideal mixture of the gases if the coal is supplied to the grate at a uniform rate, but, if not, its ability to effect mixture of the gases is not sufficient for complete combustion. With the thick fire of a chain grate stoker feeding bituminous coals, a considerable amount of combustible gas escapes from the front of the fire, such a quantity, in fact, that an ignition arch alone, although 5 ft. in length, does not cause sufficient mixture of the gas and air to produce complete combustion, therefore, if the maximum requirement of the furnace is to thoroughly mix together the gases from a chain grate fire, then the efficiency of such furnace feature as fitted under boilers *A* and *B* is ideal, because proper regulation of the quantities of air and fuel supplied by the grate resulted in the production of 18 per cent. CO_2 with complete combustion and no smoke.

The performance of the chain grate stokers under boilers *A* and *B* are unsatisfactory in two respects: First, that with desirable strength of draft the available thickness of fuel bed does not supply sufficient combustible to satisfy the air supply. Second, fuel is wasted by passing over the end of the grate with the ash. This latter fault may be remedied by running the grate at a speed which will allow the fuel to burn away before it reaches the end, but this results in increased excess of air, therefore the chain grate stoker, in combination with the above described furnace feature, is inefficient to the extent by which it fails to supply a sufficient thickness of fire or quantity of combustible, and the loss of fuel with the ash is not a fault of the stoker, because if the supply of combustible was sufficient to satisfy the air the grate could be run at a speed which would insure that the fuel all be burned.

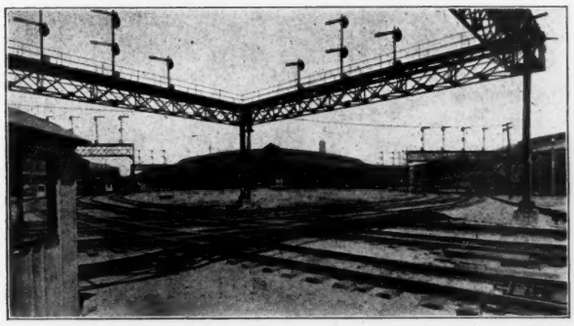


Fig. 1. Grand Crossing under Signal Bridge No. 8. Three tracks leading to each throat.

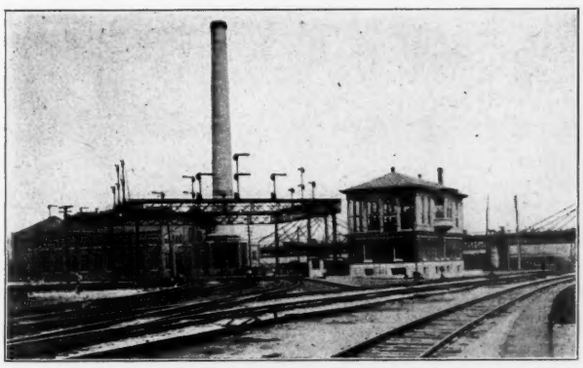


Fig. 2. Tower No. 1 and Bridge No. 8. New power house beyond Bridge.

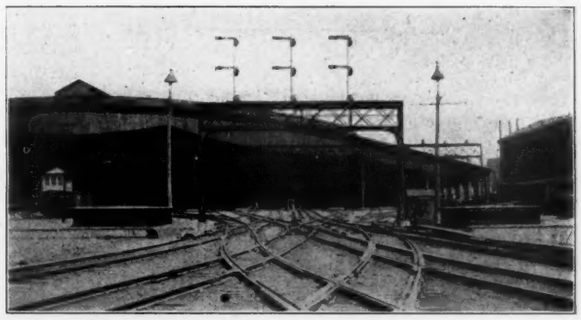


Fig. 4. East Throat, showing Three Double Slips and Bridge No. 4.

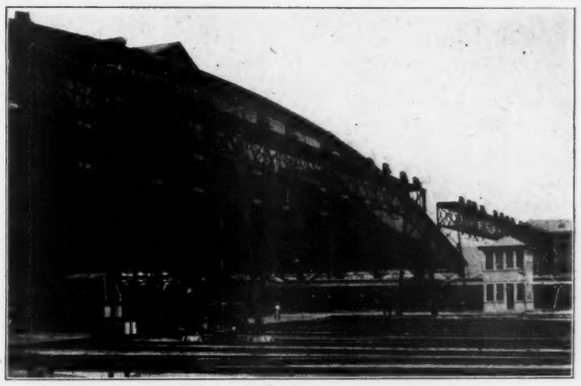


Fig. 3. Signal Bridges carrying Starting Signals for Outward Trains.

Electro-Pneumatic Signals at Union Station, St. Louis.

Signals at St. Louis Union Station.

The accompanying illustrations, Figs. 1, 2, 3 and 4, show the more interesting outward features of the extensive electro-pneumatic interlocking erected at the Union Station, St. Louis, by the Union Switch and Signal Company this year as a part of the elaborate enlargement which was made necessary at that city to accommodate the great increase of traffic in connection with the World's Fair. From the plan heretofore printed in the *Railroad Gaette* (March 20, 1903, page 212), the reader will recall that the tracks in the great train shed, which is 600 ft. wide, are divided into two groups of 16 each, with a separate throat for each group. Each "throat" has three tracks. Going out from the shed (southward), after reaching the narrowest point in the throat, which is about 400 ft. from the outer ends of the platforms, each throat is divided; three tracks turn to the west and three tracks to the east. The three eastern tracks from the western throat cross the three western tracks from the eastern throat at the "grand crossing," shown in Fig. 1. The four signal bridges required at this crossing are combined in a single rectangular structure, 75 ft. square, shown in the illustration.

The starting signal for outward trains are all "suspended signals"; the signal arms are at the lower end of the tubular post which contains the vertical operating rods, and the pneumatic valve is at the top of the post. Some of these are shown in Fig. 3. The combined length of the two bridges in this view is 488 ft.

Tower No. 1, which is just south of the rectangular signal bridge and between that and the east and west main tracks, controls all of the tracks leading to the station and all of the tracks eastward and westward in each direction from the tower for about 1,200 ft. Beyond this limit on the west is tower No. 2, and on the east is tower No. 3. The functions worked at the different towers are as follows:

Tower No. 1.—One-arm home signals, 9; two-arm home signals, 1; one-arm bridge signals, 21; two-arm bridge signals, 37; three-arm bridge signals, 2; one-arm suspended signals, 20; two-arm suspended signals, 12; dwarf signals, 37; single switches, 35; cross-overs, 15; double slips with m. p. f., 48. One hundred and three levers work 35 single switches, 15 cross-overs and 48 double slips with m. p. frogs. Seventy-eight levers work 194 signals. Total number of working levers, 181; spare spaces, 34; capacity of frame, 215 levers.

Tower No. 2.—One-arm bridge signals, 14; two-arm bridge signals, 18; dwarf signals, 3; single switches, 11; cross-over, 1; movable point frogs, 2; double slips with m. p. f., 9. Nineteen levers work 11 single switches, 1 cross-over, 2 movable point frogs and 9 double slips with m. p. f. Twenty-five levers

work 53 signals. Capacity of frame, 59 levers (44 working levers, 15 spare).

Tower No. 3.—One-arm bridge signals, 10; two-arm bridge signals, 9; dwarf signals, 3; three-arm bridge signals, 2; single switches, 10; cross-over, 1; double slips with m. p. f., 8. Fourteen levers work 10 single switches, 1 cross-over and 8 double slips with m. p. f. Twenty-one levers work 37 signals. Total working levers, 35; spare spaces, 12.

Road Tests of Brooks Passenger Locomotives.*

As the Hocking Valley desired to draw comparisons between the two types of engines used at the time in their passenger service between Columbus and Toledo, it was decided to conduct at least four trials under as near as possible identical conditions, two on each locomotive.

The locomotives were built by the Brooks works of the American Locomotive Company, the dimensions of which are given in the following pages, the greatest difference, however, being the Belpaire type of boiler, with 72-in. drivers on No. 73, and the wagon top boiler, with 66-in. drivers, on No. 80. No. 73 had been in service several years, but was thoroughly overhauled nine months previous to the trials, and had been in continuous service from that time, while No. 80 was practically new, having been in service only two months before the trial. In each case, however, where needed, the engines were given new piston rings, the valve seats were put in good condition and valves reset so that each engine worked "square."

Apparatus and Preparation.

The apparatus used was as follows: A gage glass and scale on each side of each tank for determining the amount of feed water. A Barrus calorimeter connected to the dome. A Hohmann and Maurer mercury pyrometer inserted in the front-end. Draft gages in the cab to indicate fire drafts at front-end, fire-box and ash pan. The same flue gas-sampling and collecting apparatus was used as in the previous year, and also the same combustible collector at the stack. A continuous counter was driven from the reducing motion, and also an indicator tachometer from the forward truck axle. Two indicators were used on each cylinder, with ¾-in. pipes, 9 in. long, well lagged, connecting to each end of each cylinder. The indicators used were American Thomson and Star brass outside spring. Slotted pendulum reducing motion was used, with exception of on one side of No. 80, where a pantograph was substituted on account of the air tank interfering with the other form of reducing motion, this tank being located underneath the running board. A continuous stroke counter connected with the air pump, received its motion from a small plunger working in a brass cylinder.

Method of Conducting Trials.

Since these trials extended over the whole division, a distance of 124 miles, the total amount of coal used from the time the fires were first started in raising steam until the end of the run was easily obtained. The thickness of the fire was noted at the commencement of the trial, and also the amount of coal used up to that time, when at end of trial the fire was left as near as possible in same condition. It was then allowed to burn out, then dumped and the ash pan thoroughly cleaned, so that the refuse obtained in the ash pan was from the total coal burned. The sack method was used for determining accurately the amount of coal used.

The number of injector applications was noted, so as to make correction for loss at overflow, also the number of times and length of popping of safety valve, the loss of steam in this direction being determined from a test of the pop valve while in place on the engine. The steam used by the air pump was computed from the data furnished by the New York Air-Brake Company. All readings and indicator cards were taken at intervals of four minutes, with the exception of the sample of flue gas, which was taken practically every eight minutes. On account of the risk involved, it was considered advisable to attempt to read the calorimeter only when going into the station or in pulling out; so that, probably, there would be some variation between the amount of moisture determined and the true average.

The stack-refuse sampling apparatus was constructed so that the collecting pipe could be fastened at three different points on a radius of the stack. It was clamped in each of those positions for practically one-third of the run.

GENERAL DIMENSIONS.

Hocking Valley Passenger Locomotive.

	No. 73.	No. 80.
Weight on drivers, lbs	84,000	87,000
Weight on truck wheels, lbs	44,000	46,000
Total weight, lbs	128,000	133,000
Weight of tender, lbs	95,000	102,000
Wheelbase, rigid	8′ 9″	8′ 9″
Wheelbase, total of engine	24′ 1½″	24′ 0″
Length of engine	36′ 1½″	36′ 0½″
Length of eng. and tender	59′ 3½″	59′ 4″
Height, cen. of boiler abv rails	8′ 7½″	8′ 4½″
Height, top stack above rails	14′ 11″	14′ 8″
Heating, surf., fire-box, sq. ft.	161	170
" " tubes	1,813	1,776
" " total	1,974	1,946
Grate area, sq. ft.	30.8	29
Drivers, diameter	72-in.	66-in.
Drivers, material of centers	Cast-steel.	Cast-steel.
Main wheel fit	8⅜-in.	8⅜-in.
Truck wheels, diameter	36-in.	30-in.
Journals, driving axle, diam.	8½x11 in.	8½x11 in.
Journals, truck axle, diam.	5½x12 in.	5½x12 in.
Main crank-pin, diameter	5½-in.	5½-in.
Main crank-pin, length	5½ in.	5½ in.
Cylinder, diameter	18 15/32-in.	18-in.
Piston stroke	26 in.	26 in.
Piston rod, diameter	3½-in.	3½-in.
Kind piston-rod packing	Jerome.	Downing.
Length, main rod, c. to c.	7 ft. 9 in.	7 ft. 9 in.
Steam ports, length	17 in.	17 in.
Steam ports, width	1¾ in.	1¾ in.
Exhaust ports, length	17 in.	17 in.
Exhaust ports, width	3 in.	3 in.
Bridge, width	1¾ in.	1¾ in.
Valves, kind	American.	Richards'n
Valves, greatest travel	6¼ in.	6¼ in.
Valves, outside lap	1 in.	1 in.
Valves, inside lap	0 in.	0 in.
Boiler, type	Belpaire.	Wagon top
Material in barrel	Carbn st'l.	Otis steel
Thickness of material	9/16, 5/8, 9/16 & ½"	5/8, 5/8, 9/16, and ½".
Barrel, outside diameters	62-in.	62½-in.
Kind of seams, longitudinal	Quintuple lap.	Sextuple butt.
Kind of seams, circumferenti	Double lap	Double lap
Tube sheet, thickness	¾ in.	⅝ in.
Kind of crown sheet stays	Tenn. iron.	Tenn. iron.
Dome, diameter outside	31⅛ in.	31¼ in.
Fire-box, length	108 in.	107½ in.
" width	42 "	39½ "
" depth, front	75 "	75 "
" depth, back	57 "	62 "
" material	Carbn st'l.	Otis steel
" thickness of sheets	5/16, 7/16, 5/16"	5/16, 7/16, 5/16"
" width of water space: 4" front, sides & back	3½"	4" all around
Grate, length	107 in.	106¾ in.
" width	34 "	34 "
" kind	Rocking finger.	
" No. of bars	10	10
Tubes, No.	301	295
" material	Shelby st'l	Shelby st'l
" outside diameter	2-in.	2-in.
" length over sheets	11 ft. 7 in.	11′ 7 1/16″
Smoke-box, outside diameter	65 in.	65 in.
Smoke-box, length	60 in.	60 in.
Exhaust nozzle:		
Single or double	Single.	Single.
Fixed or variable	Fixed.	Fixed.
Diameter	4⅝-in.	5-in.
Dist., tip from c. of boiler	2½" abv.	7 in. belw.
Netting, size of mesh	¼x1¼-in.	¼x1½-in.
Stack, kind	Tank steel	C. I., taper
Stack, diameter in	12½, 15⅞	14½, 17⅞
Stack, height abv smoke-box	43 in.	43 in.
Ratio, air space to grate area	45%	45%
Width of air space	⅝-in.	⅝-in.
Tender, type	8-wheeled.	8-wheeled.
Wheels, diameter	33 in.	33 in.
Journals, diameter	5 "	5 "
Journals, length	9 "	9 "
Distance between centers	76 "	76 "
Diameter of center of axle	5⅝"	5⅝"
Length, tndr. over bumper bar	22′ 10¾"	23 ft.
Tank capacity, gal.	5,000	5,000
Kind of materia!	Steel.	Steel.
Length of tank	19 ft. 6 in.	19 ft. 6 in.
Width of tank	9 " 10 "	9 " 10 "
Height of tank to collar	4 " 6 "	4 " 6 "
Tires, make	Midvale.	S. St'l Co.
Sight feed lubricator	Michigan triple.	
Front and back couplers:		
Buckeye; shank	Short	Long.
Safety valve (each 3-in.)	Coale.	Hayden.
Sanding devices	Leach "D" 2 double.	Leach "A" double.
Injectors, two each	Ohio No. 8.	Ohio No. 9.
Air-brake equipment	New York.	New York.
Tender brake-beam	Monarch.	Simplex.
Tender brake shoe	Brooks.	A. L. Co.'s
Steam gages	Ashcroft.	Star.

GENERAL RESULTS.

Boiler Performance.

	No. 80.	No. 80.
1. No. of trial	2	3
2. Date of trials	May 3, '04	May 6, '04
3. Duration trials, total, hrs.	2.96	2.64
4. Running time	2.58	2.36
5. Steaming time	2.31	2.09
6. Number of stops	13	11
7. Kind of fuel	Hocking.	Hocking.
8. State of weather	Clear.	Clear.
9. Direction of wind	E. & S.	E. & S.
10. Velocity wind, miles pr hr	8	6

Average Pressures.

11. Steam press. at dome, lbs.	166	157
12. Barometer, in.	28.07	29.21
13. Absolute steam press., lbs	180	171
Force of draft:		
14. Front end, in.	2.05	2.31
15. Fire-box, in.	1.19	1.5
16. Ash-pan, in.	0.11	0.1

Average Temperatures.

	Degs. Fahr.	
17. External air	65	75
18. Escaping gases	728.3	753
19. Feed-water in tank	58	62

Fuel.

20. Size	Lump.	Lump.
21. Thickness of fire, in	11 to 14	11 to 14
Weight of coal:		
22. Fired, lbs.	7,568	7,508
23. Before start, lbs	1,164	1,067
24. During run, lbs.	6,404	6,441
26. Percentage of moisture in coal by analysis, per. ct.	7.20	7.28
26. Weight dry coal fired, lbs	5,943	5,972
27. Weight, refuse in pan, lbs.	715	769
28. Percentage of refuse in pan to coal, per cent.	9.45	10.22
29. Combustible in refuse, lbs.	309	371
30. Total combustible minus comb. in pan, lbs.	6,131	5,786
31. Total ash by analysis, lbs.	583	655
32. W't, ash passing flues, lbs.	177	257
33. T'l refuse pass'g flues, lbs.	730	959
Percentage:		
34. Ash lost to total ash, p.c.	30.4	39.25
35. Refuse through stock to coal, per cent.	9.65	12.78
36. Equivalent coal actually burned, lbs.	5,743	5,566
37. Net dry coal burned, lbs.	5,320	5,160
38. Net combustible burned, lbs	4,890	4,565

Fuel Analysis—Proximate Analysis.

	Per cent.	
39. Fixed carbon	49.24	49.70
40. Volatile matter	35.86	34.30
41. Moisture	7.20	7.28
42. Ash	7.70	8.72

Ultimate Analysis.

	Per cent.	
43. Carbon	68.9	68.58
44. Hydrogen	5.45	5.45
45. Oxygen	16.0	15.0
46. Nitrogen	1.2	1.2
47. Sulphur	0.75	1.05
48. Ash	7.70	8.72

Analysis of Pan Refuse.

	Per cent.	
49. Combustible	43.28	48.18
50. Ash	56.72	51.82

Analysis of Stack Refuse.

	Per cent.	
51. Combustible	75.77	73.20
52. Ash	24.23	26.80

Fuel per Hour Steaming Time.

53. Actual coal fired, lbs.	2,772	3,081
54. Equiv. coal burned, lbs.	2,486	2,663
55. Combustible burned, lbs.	2,112	2,187
56. Actual coal fired, per sq. ft. grate	95.6	106.2
57. Equivalent coal burned, per sq. ft. grate	85.7	91.8
58. Combustible burned per sq. ft. grate	72.7	75.4
59. Combustible burned per sq. ft. heating surface	1.08	1.12

Calorific Value of Fuel.

Calorific value per pound:		
60. Of actual coal by Mahler Calorimeter	12,135	12,184
61. Of dry coal	13,080	13,120
62. Of combustible	14,265	14,854
63. Of stack refuse	10,750	10,390

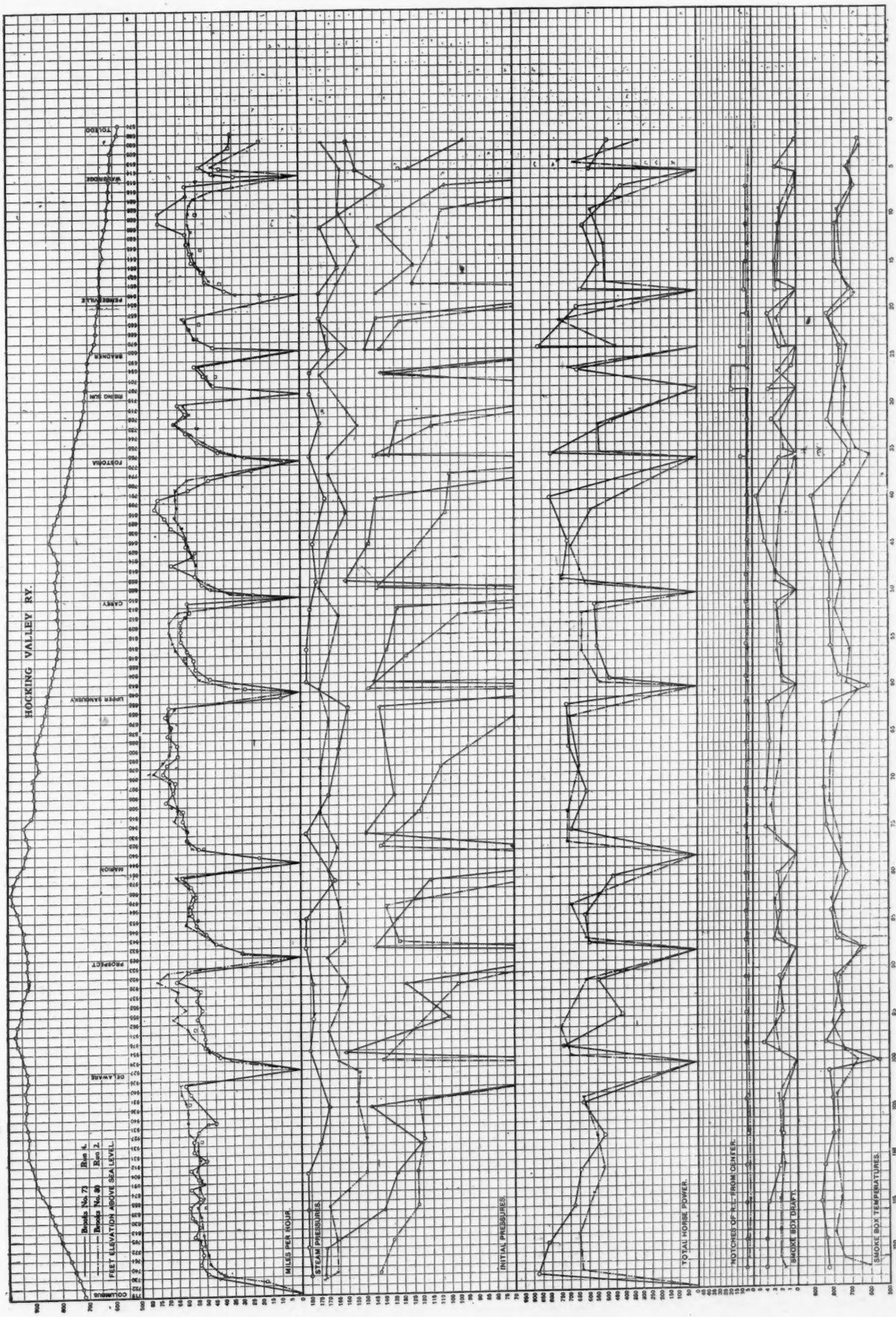
Quality of Steam.

64. At dome, dry steam-unity	0.9774	0.983
65. Quality correction	0.9843	0.988

Water.

66. Actual weight, water fed to boiler, lbs	38,580	40,785
67. Equiv. weight of water actually evaporated into dry steam, lbs.	37,963	40,275

*From a paper by E. A. Hitchcock, read before the American Society of Mechanical Engineers, December, 1904.



Graphical Record of Tests of Brooks Passenger Locomotives, Hocking Valley.

68. Factor of evaporation	1.21	1.207
69. Equiv. water evaporated into dry steam, from and at 212 degs.....	45,935	48,612

Water per Hour Steaming Time.

Equivalent evaporation per hour:		
70. From and at 212 degs.	15,500	18,400
71. From and at 212 degs. per sq. ft. heatg surf.	7.97	9.45
72. H.p. developed by boiler (34.5-lb. rating)	449	533

Economic Results.

73. Water apparently evap. under actual conditions, per lb. of coal as fired..	6.02	6.33
Equiv. evap. from and at 212 degrees:		
74. Per lb. actual coal fired.	7.18	7.55
75. Per lb. of dry coal fired.	7.73	8.14
76. Per lb. of combustible, minus pan combustible	8.85	9.81
77. Per lb. equiv. coal b'rn'd	8.00	8.73
78. Per lb. dry coal burned.	8.63	9.42
79. Per lb. combustible brnd	9.4	10.6

Efficiencies.

Efficiency of boiler:		
80. From combustible, minus pan combustible..	60	64
81. From combustible brnd.	63.7	69.0
82. And furnace from coal fired.	57.2	59.8

Fuel Gas Analysis by Weight.

83. CO_2 = Carbon dioxide ..	15.41	15.45
84. O = Oxygen	7.25	8.54
85. CO = Carbon monoxide..	1.14	0.01
86. N = Nitrogen	76.20	76.0
87. Percentages of air excess.	46.44	59.09

Heat Balance.

	B.t.u.	P. ct.	B.t.u.	P. ct.
Loss pr lb. coal due to:				
88. Products of combstn	1,371	11.3	1,343	11.03
89. Air excess	539	4.44	683	5.61
90. Latent heat	497	4.09	492	4.04
91. Unbrnd. coal in pan	538	4.44	657	5.40
92. The same, passing out stack	1,140	9.39	1,320	10.83
93. CO.	671	5.53	5	0.04
94. Radiation, etc	439	3.61	394	3.24
95. Heat used in evap..	6,940	57.2	7,290	59.81
96. Total heat supplied...	12,135		12,184	

Engine Performance.

No. of cars in train.....	4	4
Gross load in tons	143	143
Total miles	123.7	123.7
Total revolutions	...	37,830
Average speed in miles per hr.	47.9	52.4
Average revs. per min.....	244	266
Steam pressure by gage.....	166	157
H.-p., right cylinder, head end	148	169
" " " crank end	140	161
" left " head end	157	183
" " " crank end	169	192
Total	614	705
Safety valve:		
No. times popped	9	3
No. of seconds on	705	150
Pounds of steam escaped..	1,596	340
Steam lost at calorimeter and aspirator	229	224
Dry steam lost by pop, calorimeters and aspirator....	1,825	564
Dry steam used by engine and air pump.	36,138	39,711
Total hours throttle open....	2.31	2.09
Indicated horse-power, hours.	1,420	1,472
Lbs. dry steam per i.h.p. per hour, including air pump	25.6	27
Total strokes of air pump....	5,010	5,136
Dry steam used by air pump..	731	750
Lbs. dry steam per i.h.p. per engine alone	24.94	26.41
Ton-miles	17,690	17,690
Coal per ton-mile, lbs.....	0.362	0.364
Steam per ton-mile, lbs.....	2	2.2

Boiler Performance.

	No. 73.	No. 73.
1. No. of trial	4	5
2. Date of trials	May 13,'04	May 21,'04
Duration of trials:		
3. Total, hours	3.09	3.02
4. Running time.....	2.61	2.65
5. Steaming time	2.34	2.34
6. No. of stops	13	13
7. Kind of fuel.....	Hocking.	Hocking.
8. State of weather	Clear-Cloudy.	Clear.
9. Direction of wind.....	S. W.	N. W.
10. Velocity wind, miles pr hr	17	8

Average Pressures.

11. Steam press. at dome, lbs.	174	170
12. Barometer, in.	29.13	29.21
13. Absolute steam press., lbs.	188	184
14. Force of draft, frnt end, in.	2.5	3.0
15. " " fire-box, in.	1.91	1.8
16. " " ash-pan, in.	0.17	0.2

Average Temperatures.

17. External air .....degs. F.	68	69
18. Escaping gases.... "	778	775
19. Feed-water in tank "	76	67

Fuel.

20. Size	Lump.	Lump.
21. Thickness of fire, in.....	11 to 14	11 to 14
22. Weight of coal fired, lbs..	8,197	8,865
23. W't coal before start, lbs.	1,746	1,746
24. W't coal during run, lbs.	6,451	7,119
25. Moisture in coal, analysis, %	6.84	6.70
26. W't. dry coal fired, lbs....	6,010	6,642
27. W't. of refuse in pan, lbs.	952	830
28. Refuse in pan to coal, p.ct.	11.62	9.35
29. Combustible in refuse, lbs.	396	289
30. Total combustible minus comb. in pan, lbs.....	6,403	7,113
31. Total ash by analysis, lbs..	838	869
32. Weight of ash passing flues, lbs.	282	328
33. Total refuse passg flues, lbs	874	1,285
34. Percentage of ash lost to total ash, per cent.....	33.66	37.8
35. Percentage refuse through stack to coal, per cent	10.66	14.5
36. Equivalent coal actually burned, lbs.	5,667	5,996
37. Net dry coal burned, lbs...	5,280	5,585
38. Net combustible brnd, lbs.	4,698	5,000

Fuel Analysis—Proximate Analysis.

	Per cent.	
39. Fixed carbon	48.78	47.84
40 Volatile matter	34.16	35.66
41. Moisture	6.84	6.70
42. Ash	10.22	9.80

Ultimate Analysis.

43. Carbon	69.13	68.08
44. Hydrogen	5.40	5.40
45. Oxygen	13.0	14.0
46. Nitrogen	1.2	1.2
47. Sulphur	1.05	1.52
48. Ash	10.22	9.80

Analysis of Pan Refuse.

	Per cent.	
49. Combustible	41.62	34.86
50. Ash	58.38	65.14

Analysis of Stack Refuse.

	Per cent.	
51. Combustible	67.68	74.47
52 Ash	32.32	25.53

Fuel per Hour Steaming Time.

53. Actual coal fired, lbs.....	2,757	3,042
54. Equiv. coal burned, lbs...	2,421	2,562
55. Combustible burned, lbs..	2,007	2,136
56. Actual coal fired per sq. ft. grate, lbs.....	89.5	98.7
57. Equiv. coal burned per sq. ft. grate	78.6	83.2
58. Combustible burned per sq. ft. grate	65.1	69.3
59. Combustible burned per sq. ft. heating surface.....	1.01	1.08

Calorific Value of Fuel.

Calorific value per pound:		
60. Of actual coal by Mahler Calorimeter	12,230	12.151
61. Of dry coal	13,130	13,020
62. Of combustible	14,775	14,560
63. Of stack refuse	9,590	10,550

Quality of Steam.

64. At dome, dry steam-unity	0.9824	0.9824
65. Quality correction	0.987	0.9871

Water.

66. Actual weight of water fed to boiler, lbs.	43,940	43,950
67. Equiv. w't. of water actually evap. into dry stm.	43,369	43,383
68. Factor of evaporation	1.195	1,202
69. Equiv. water evap. into dry steam from and at 212 degs.....	51,826	52,146

Water per Hour Steaming Time.

Equivalent evaporation per hr.:		
70. From and at 212 degs.	16,770	17,270
71. From and at 212 degs per sq.ft. heating surf	8.49	8.75
72. H.-p. developed by boiler (34.5-lb. rating)	486	500

Economic Results.

73. Water apparently evaporated under actual con-dit'ns pr lb. coal as fired	6.81	6.17
Equiv. evap. from and at 212 degs per lb. of:		
74. Actual coal fired.....	8.03	7.32
75. Dry coal fired.....	8.62	7.86
76. Comb. minus pan comb.	10.3	9.13
77. Equiv. coal burned.....	9.14	8.71
78. Dry coal burned	9.82	9.35
79. Combustible burned	11.1	10.4

Efficiencies.

Efficiency of boiler:		
80. From combustible minus pan combustible	67.5	60.6
81. From combustible burnd	72.0	69.3
82. And furnace from coal fired	63.4	58.2

Flue Gas Analysis by Weight.

83. CO_2 = Carbon dioxide ...	16.53	16.11
84. O = Oxygen	7.4	7.56
85. CO = Carbon monoxide .	0.02	0.28
86. N = Nitrogen	76.05	76.05
87. Percentage of air excess..	48.11	49.53

Heat Balance.

	B.t.u.	P. ct.	B.t.u.	P. ct.
Loss per lb. coal due to:				
88. Products of combstn	1,528	12.48	1,419	11.67
89. Air excess	628	5.13	595	4.9
90. Latent heat	488	3.99	496	4.08
91. Unbrnd coal in pan	660	5.39	439	3.61
92. The same, passing out stack	1,018	8.32	1,653	13.6
93. CO	11	0.09	147	1.21
94. Radiation, etc.....	137	1.12	327	2.66
95. Heat used in evaporin	7,760	63.48	7,075	58.27
96. Total heat supplied.	12,230		12,151	

Engine Performance.

	No. 73.	No. 73.
No. of cars in train.....	4	4
Gross load in tons	143	143
Total miles	123.7	123.7
Total revolutions	34,201	...
Average speed in miles per hr	47.4	46.6
Average revs. per min.....	221	218
Steam pressure by gauge	174	170
H.-p. right cylinder, head end.	143	163
" " " crank end	148	167
" left " head end..	167	174
" " " crank end	171	169
Total	629	673
Safety valve:		
No. times popped.....	29	14
No. of seconds on.....	1,630	580
Lbs. of steam escaped.....	1,596	568
Steam lost at calorimeters, dome and aspirator.....	227	236
Dry steam lost by pop, calorimeters and aspirator.....	1,823	804
Dry steam used by engine and air pump	41,544	42,579
Total hours throttle open....	2.34	2.34
Indicated horse-power hrs....	1,472	1,576
Lbs. dry steam per i.h.p. per hr., including air pump....	28.2	27.2
Total strokes of air pump....	5,040	5,408
Dry steam used by air pump..	753	790
Lbs. dry steam per i.h.p. per engine alone	27.7	26.5
Ton-miles	17,690	17,690
Coal per ton-mile, lbs.....	0.364	0.402
Steam per ton-mile, lbs.	2.31	2.36

GENERAL RESULTS.

From the readings taken curves are plotted between mile posts as abscissæ and the following: Feet elevation of road; miles per hour; steam pressure; initial pressure in cylinder; total horse-power; notches of reverse lever from center, smoke-box draft and smoke-box temperature. There are two sets of curves on each sheet (one sheet only shown herewith—Editor), one set for each engine, thereby showing at once the relative workings of the two at any point in the road.

Although the results of four trials are given, five runs were made in all; the results of the first one on number 80 not being given, as it served as a practice trial in many respects, some of the observations not being complete, and then, also, on account of the cool weather it was necessary to have steam on the train, which fact, however, when the following runs were made, gave some figures on the amount of steam required to heat the train, made up of four vestibule cars; that is, one combined baggage and mail car, two coaches and one parlor car.

The total water used on this run was about 4,200 lbs. more than on the following trials, all conditions being very nearly the same, with the exception of wind and outside temperature, which was 11 miles per hour from the north, with a temperature of 43 deg. Fahr., as against eight miles per hour from the southeast at a temperature of 65 deg. Fahr. All the general results lie quite closely together, or as close as could be expected, when consideration is taken of the irregularities that are bound to creep in on a regular service test. In comparing runs 2 and 3, in the latter case the speed was much higher and consequently the amount of steam used greater. This was due to lateness in starting, thereby making an average speed in miles per hour of 52.4 and a maximum indicated horse-power at one point of 1,383, yet the maximum speed for No. 80 was on trial No. 2 78 miles per hour. On trials 4 and 5, with engine No. 73, the maximum speed attained was very nearly 82 miles per hour and the maximum indicated horse-power 935, there not being such a variation as in the trials on No. 80 since the time in motion were almost identical. In every case the highest speeds, as shown on the curve, were reached at the same points in the road, between mile posts 90 and 91, also between mile posts 68 and 69.

In comparing the several heat balances, although as a whole they are quite similar, the slight variations that do exist may be explained. With trials 2 and 3 the greater loss out of the stack in trial 3 is due to the

much higher speed. Trial 2 shows a much greater loss, due to formation of CO. If that factor had been practically eliminated, as in trial No. 3, although the loss due to air excess would probably have increased, due to more free oxygen in the escaping gases, yet there would be a consequent increase in the boiler efficiency, putting it above that of trial No. 3, on account of the less loss from the stack. Therefore, with the same losses out the stack the efficiencies would be very nearly the same. In trials 4 and 5 the greatest difference is in the loss from the stack, with also about the same difference between the boiler efficiencies, but when the difference in the loss due to unburned coal in the pan is taken into account, the boiler efficiency for some reason on trial 4 is too high. This is accounted for by the fact that during trial No. 4 the mud ring started to leak and, as this could not very conveniently be gaged, or very accurately estimated, the total amount of feedwater to boiler used in computing the final results, the evaporating and consequently the boiler efficiency would run higher than the true value, with a consequent reduction, as found, in the loss due to radiation, etc.

Considering this loss on trial 4 as unreliable and taking the average unaccountable loss of the other trials and comparing with the same losses obtained in the same way on the consolidation freight referred to before, the passenger runs give 3.18 per cent. and 1.55 per cent. for the freight, which figures would not necessarily indicate that the loss in this direction was less in case of the consolidation engines, in view of the way this loss is determined, that is, by difference, thereby containing all errors of observation, sampling, etc., and thereby a small percentage of difference in one large item of the heat balance would make a large percentage in that of the "unaccountable loss and radiation." All the heat balance results obtained thus far seem to indicate that the loss referred to would be about 3 per cent., which is about what might be expected for that type of boiler working under the conditions found.

It is also of interest to note that the average loss due to unburned coal out the stack for the two trials with Hocking coal on the freight engine was 14.48 per cent., while for the passenger engine, with the same kind of coal, the average of the four trials is 10.53 per cent.

Interior of Observation Compartment.

Interior of Smoking Compartment.

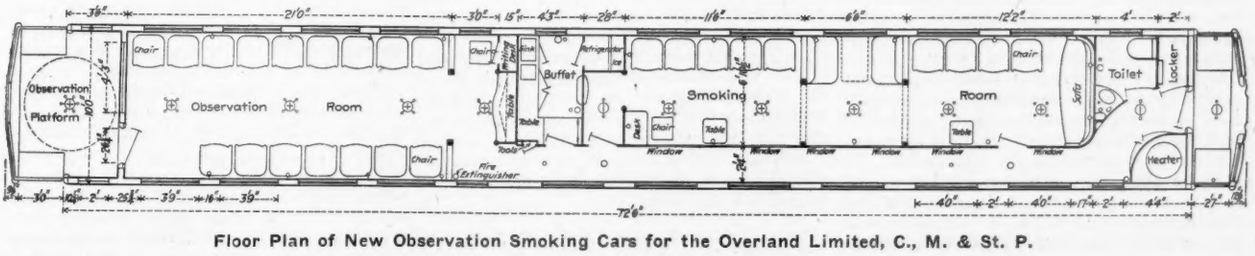
Composite Observation Cars for the C., M. & St. P.

The "Overland Limited" trains of the Chicago, Milwaukee & St. Paul, running between Chicago and Omaha, will soon have added to their equipment a new design of observation car different in some ways from anything heretofore used. As may be seen from the floor plan it is a combination smoking and observation car, in which the smoking room is enclosed and separated from the observation end. The comfort of women passengers was the primary object of the design.

It will be observed that the observation room is reached by a corridor along one side of the car as in compartment sleeping cars. The car, which is 72 ft. 6 in. long over end sills, contains only the two rooms, and both are therefore spacious. The interior design and finish is artistic and pleasing, the treatment being in the new L'Art Noveau style. The woodwork is St. Jago mahogany and is inlaid with marquetry designs. Many rare woods have been used in this ornamentation, including tulip, amaranth, saffron, olive, boxwood, satinwood, English oak, white holly, prima vera and cocobola. The carpets are woven to a special design to conform to the ornamentation of the car. The upholstering in the observation room is frieze plush and in the smoking room Spanish effects in leather are used. All of the hardware, lamps, etc., were specially designed for the car.

A buffet is placed between the two compartments and is accessible from either. At the forward end of the smoking room is a large lounge, above which is a handsome mirror surrounded by a frame of Tiffany illuminated glass. Both rooms have writing desks and in the observation room is a library, and cases for periodicals. Particular attention was paid to the lighting of the car and each passenger will have ample light for reading purposes. The smoking room has specially designed exhaust ventilators to draw out the smoke rapidly.

The cars are built with the heaviest framing the builders have ever used. In addition



Floor Plan of New Observation Smoking Cars for the Overland Limited, C., M. & St. P.

to the usual framing for cars of this kind, the ends are further reinforced with a composite iron and steel structure reaching from the end plate to the sill with steel plates laid in parallel with the end posts. The whole structure is tied together with a plate in the end sills. In the underframing there are four steel plates running the full length of the car and connected to the plates in the end sill, forming an unusually strong and rigid construction. The builders are the Barney & Smith Car Company.

Fuel Consumption of Locomotives.*

The fuel bills of a railroad constitute ordinarily about 10 per cent. of the total expense of operation, or from 30 to 40 per cent. of the actual cost of running the locomotive. On important systems the gross amount of coal burned assumes a very large figure—running into millions of tons. Each engine will probably consume $5,000 worth of coal in a year on the average, so that for 1,000 locomotives the annual coal bill would approximate $5,000,000. While this is one of the largest items of expense, there is probably less actually known about it than any other account. We may know in a general way that an engine of a certain class, loaded with a definite tonnage, will haul its train in a given direction over a particular division with a consumption of so many pounds of coal per 100 ton miles, but here our knowledge stops, and if it should be asked how much is used in ascending the maximum grade, how much on the subordinate grades, and what quantity on the level, there is little likelihood of receiving a correct answer.

The reason for this lack of definite information is not hard to find; in fact it is quite obvious. While it is a comparatively simple matter to determine the quantity of coal used on a trip throughout a run, by means of track scales and measured supplies taken en route, it is very difficult and laborious to sub-divide it between terminal points, in the proper proportion to the work done on each of the various grades. An approximation is sometimes obtained by counting the shovelfuls thrown into the fire-box between different points, but this, of course, cannot be considered an accurate method. The ordinary exigencies of railroad traffic are so many and varied that it is almost impossible to maintain fixed conditions for a length of time sufficient to determine factors of unquestioned value.

The same comments apply equally to the consumption of water. Even if meters be placed in the feed pipes, the inconvenient location for observation and the variable methods of working the injector by allowing different heights of water in the boiler, not to speak of leaks and wastes, militate against accurate measurements. Thanks, however, to the "Locomotive Testing Plant," we are now able to work an engine for a long period under constant conditions, and at the same time make accurate measurements of the fuel and water consumed.

Several years ago, when connected with the Chicago & North Western Railway, the author was able to make a complete set of tests with the standard heavy freight engine of that road, first upon the testing plant and afterwards in road service with a dynamometer car. Using the results of these tests as a foundation, it has been found possible to elaborate a diagram for practically any particular locomotive whose general dimensions are known, which will give at once the coal consumption per mile or per hour for various grades and speeds or train loads. This diagram is based upon theoretical as well as practical considerations, and will, it is believed, give values agreeing closely with actual conditions.

The construction of the diagram and the method of using it can, perhaps, be made most clear, by assuming a locomotive of certain proportions, and developing the study for this engine. We will therefore consider a consolidation locomotive or 2-8-0 type having the following general dimensions:

Diameter of cylinders	21 in.
Stroke of piston	32 in.
Diameter of drivers	56 in.
Boiler pressure	200 lbs.
Grate area	40 sq. ft.
Heating surface	3,200 sq. ft.
Weight of engine and tender	150 tons

The theoretical tractive force of such a locomotive will be

$$T.\ T.\ F. = \frac{P\ d^2\ s}{D} \quad \ldots\ldots\ldots\ldots 1$$

where P = Boiler pressure in pounds per sq. in.
d = Diameter of cylinder in inches.
s = Stroke of piston in inches.
D = Diameter of drivers in inches.

When we allow for drop in steam pressure and internal resistance, we find that the available tractive force at circumference of the drivers is only eight-tenths of the theoretical tractive force, or,

$$A.\ T.\ F. = \frac{.8\ P\ d^2\ s}{D} \quad \ldots\ldots\ldots\ldots 2$$

for simple engines, when working at slow speeds with the reverse lever in the corner notch.

For the engine under consideration we therefore find as follows:

$$T.\ T.\ F. = \frac{200 \times 441 \times 32}{56} = 50{,}000 \text{ lbs. approx.}$$

$$A.T.F. = .8 \times 50{,}000 = 40{,}000 \text{ lbs. approx.}$$

As the speed of the locomotive increases, however, beyond the point where the boiler can supply the complete volume of the cylinders at each stroke, an earlier cut-off must be used, and it is necessary to determine the effect of such a change. In order that this may occur at the maximum possible speed, the boiler must be worked to its full capacity, which is limited by its ability to burn fuel. From various tests it seems as if this limit might be considered as stated below, the quantities being expressed in pounds of coal per square foot of grate area per hour:

Bituminous coal	200 lbs.
Anthracite, large sizes	100 "
Anthracite, small sizes	60 "

We will assume that our engine is burning Pennsylvania or Virginia semi-bituminous coal, therefore the maximum combustion will be $40 \times 200 = 8{,}000$ lbs. coal per hour. We admit that this is a large amount to be handled by one man for any great length of time, but there is no doubt that it could be burnt, if supplied.

In order to determine the quantity of steam generated by this amount of fuel in the boiler which we have assumed, Fig. 1 is introduced. This has been compiled from various sources of information, and, it is thought, fairly represents the average practice in this country. In this figure, the ordinates give the maximum evaporation in pounds of water from and at 212 deg. Fahrenheit per square foot of heating surface per hour that can be expected under ordinary conditions, as stated above, the abscissæ denoting the ratio of heating surface to grate area. For the engine in question this will be

$$\frac{3200}{40} = 80,$$

and for semi-bituminous coal, curve c, we find that with a ratio of 80, 15 pounds of water, from and at 212 deg., may be evaporated per hour from each square foot of heating surface, or for the boiler as a whole, $3{,}200 \times 15 = 48{,}000$ lbs. per hour.

The factor of evaporation from ordinary temperatures of feed water, will be about 1.2, so that we shall have at boiler pressure,

$$\frac{48{,}000}{1.2} = 40{,}000 \text{ lbs. per hour.}$$

The steam will be somewhat reduced in pressure at the cut-off point, however, and the table here given indicates the probable relation of this pressure to the boiler pressure, when the reverse lever is in the corner notch, and the throttle wide open.

Ratios of Cut-Off Pressure to Boiler Pressure.

Revs. per min.	Starting.	50.	100.	150.	200.
Long ports	.98	.94	.88	.83	.78
Short ports	.98	.92	.85	.77	.72
Medium ports	.98	.96	.86	.80	.75

By long ports is meant those in which

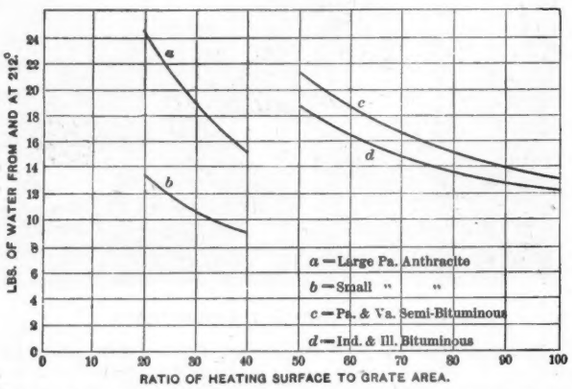

LBS. OF WATER FROM AND AT 212°
RATIO OF HEATING SURFACE TO GRATE AREA.
a = Large Pa. Anthracite
b = Small " "
c = Pa. & Va. Semi-Bituminous
d = Ind. & Ill. Bituminous

Fig. 1—Maximum Hourly Evaporation per Square Foot of Heating Surface.

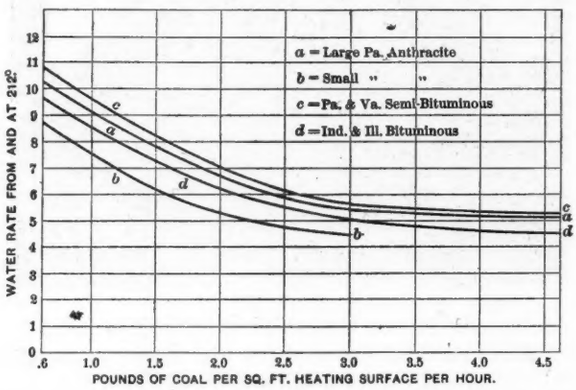

WATER RATE FROM AND AT 212°
POUNDS OF COAL PER SQ. FT. HEATING SURFACE PER HOUR.
a = Large Pa. Anthracite
b = Small " "
c = Pa. & Va. Semi-Bituminous
d = Ind. & Ill. Bituminous

Fig. 3—Evaporative Value of Coal.

*From a paper by Mr. G. R. Henderson, read before the American Society of Mechanical Engineers, December, 1904.

the length of port in inches divided by the area of the cylinder in square inches is approximately .12, and by short ports, where this ratio is about .05. If we assume .90 for the ratio in the case in hand, we shall have $200 \times .90 = 180$ lbs. at cut-off, which steam will weigh .432 lbs. per cu. ft. The volume of a cylinder 21 in. diameter and 32 in. long is 6.4 cu. ft., or for one revolution four times this amount or 25.6 cu. ft. No allowance is made for clearance, as the cut-off, with lever in the corner, is usually about 90 or 92 per cent. of stroke. For each revolution, then, the steam consumption will be

$$25.6 \times .432 = 11.06 \text{ lbs.}$$

and

$$\frac{40{,}000}{60 \times 11.06} = 60 \text{ revolutions per minute.}$$

as the maximum speed at which the boiler will furnish steam at full stroke. The speeds in miles per hour corresponding to the revolutions per minute for a 56-in. wheel are as follows:

5	10	15	20	25	30	35	40	miles per hour.
30	60	90	120	150	180	210	240	revs. per min.

therefore it is plain at above 10 miles an hour, the cut-off must be reduced, diminishing the available tractive force of the engine.

A study of the variation in tractive force due to speed indicates that the method explained below gives a close approximation to actual results.

In Fig. 2 the ordinates represent the tractive force in pounds, and the abscissæ the speed in miles per hour. As the maximum speed at full stroke was found to be 60 revolutions per minute or 10 miles an hour, we find the intersection of this speed with the theoretical tractive force at *A*. We therefore construct an equilateral hyperbola through this point, that is a curve the product of whose ordinates will always have the same value, viz., $50{,}000 \times 10 = 500{,}000$. As we have seen, the available tractive force, however, cannot exceed 40,000 lbs. By drawing from the point *B* a tangent to the hyperbola, we then have a locus consisting of a straight line and a curve, and this locus gives us the maximum available tractive force (at circumference of the drivers) for which the boiler will supply the cylinders at any speed. But to do this, we must burn 8,000 lbs. of coal an hour, so that the locus *BC* also gives the combinations of speed and available tractive force which may be obtained by the combustion of 8,000 lbs. of coal an hour.

The rate of combustion per sq. ft. of heating surface per hour is $\frac{8{,}000}{3{,}200} = 2.5$ and from Fig. 3 (curve *c*) we should expect 6 lbs. of water per pound of coal from and at 212 deg., or a total steam production of 8,000 $\times$ 6 = 48,000 lbs., which is the same as our first figure. If the rate of combustion be reduced, however, there will be more steam generated per pound of coal, as indicated by Fig. 3. For instance, if three-quarters the amount be consumed, or 6,000 lbs., the rate of combustion will be $\frac{6{,}000}{3{,}200} = 1.87$ lbs. per sq. ft. of heating surface, and from Fig. 3 the evaporation will be about 7 or $7 \times 1.87 = 13.09$ lbs. of water per sq. ft. of heating surface per hour, instead of 15 lbs. as before. This would supply the cylinders at full stroke for 15: 13.09:: 10: 8.7 miles an hour. From this, as a starting point, we construct a new hyperbola and tangent as before, which locus gives the combinations of speed and tractive force for 6,000 lbs. of coal an hour. In the figure, the loci have been drawn for each thousand pounds per hour from 1,000 to 8,000.

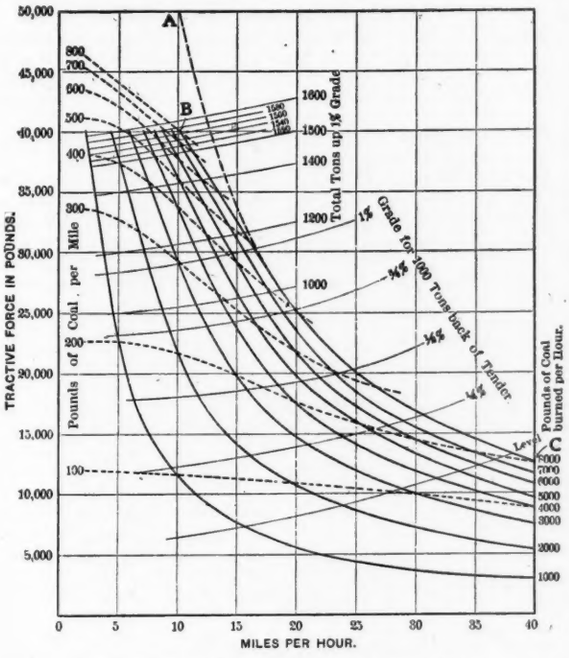


Fig. 2—Coal Consumption of Locomotives.

If, now, we divide the quantities per hour by the speed, we obtain the fuel consumption per mile, and this is shown by the dotted lines. Thus with a tractive force of 20,000 lbs. and a speed of 15 miles an hour, we should expect an hourly consumption of 3,000 lbs. or 200 lbs. per mile.

But as our diagram (Fig. 2) is based on speed and tractive force as co-ordinates, we can construct additional curves, which may represent the force needed to pull various trains at different speeds or up grades. For instance, if we consider a train of 1,000 tons weight back of tender, or 1,150 tons total weight, we can lay down the curves of resistance for a level, ¼, ½, ¾ and 1 per cent. grade, as shown in the diagram. By this means we can determine the quantity of coal that would be used on different portions of a division.

If there were 40 miles each of level, ½ and 1 per cent. grade, the fuel consumption would run as follows:

	Lbs.
40 miles @ 38 miles an hr., 210 lbs. pr mile =	8,400
40 miles @ 24 miles an hr., 330 lbs. pr mile =	13,200
40 miles @ 17 miles an hr., 490 lbs. pr mile =	19,600
Total	41,200

It will be noticed that this considers the train to be run at the maximum speed which the engine can make on each grade or portion of track. If the speed be limited to 15 miles an hour uniformly, we should expect consumption as follows:

	Lbs.
40 miles on level @ 50 lbs. per mile =	2,000
40 miles on ½% grade @ 190 lbs. per mile =	7,600
40 miles on 1% grade @ 430 lbs. per mile =	17,200
Total	26.800

This trip of 120 miles will, however, require eight hours for its completion, whereas the first schedule is a trifle over five hours. The coal consumption in the first case is over 50 per cent. greater than in the second case. The effect of speed upon the coal pile is clearly shown by following any of the grade lines in the diagram. The rate per mile on a ½ per cent. grade will be about as given below:

Miles per hour	5	10	15	20
Coal per mile, lbs...	150	160	185	250

The influence of loading is shown by the curves marked "Total tons up 1 per cent. grade."

At 10 miles an hr.,	250	lbs.	per	mile	for	1,000	tons.
" 10	"	"	"	325	"	"	"	"	1,200	"
" 10	"	"	"	500	"	"	"	"	1,400	"

When we near the limit of capacity of the engine, the difference is still more marked.

At 10 miles an hr.,	630	lbs.	per	mile	for	1,500	tons.
" 10	"	"	"	680	"	"	"	"	1,520	"
" 10	"	"	"	720	"	"	"	"	1,540	"
" 10	"	"	"	780	"	"	"	"	1,560	"

Again, 1,600 tons can be hauled at five miles an hour with a consumption of 500 lbs. per mile, whereas 1,570 tons at 10 miles an hour will require 800 lbs. per mile, both cases being the maximum that the engine can do.

These examples give an idea of the variety of problems in fuel consumption which can be quickly solved by the aid of this diagram. It is true that a different diagram must be made for each class of engine, but this is a comparatively small matter. With the increase in speed and loads of the present day, the coal consumption becomes a topic of great interest, and when comparisons are made with previous schedules, there is an apparent decrease in the economy of fuel, unless the various points are duly considered, and as explained by the chart.

Wind Pressure Involved in the Wreck of a High Bridge.*

BY C. A. P. TURNER, M. AM. SOC. C. E.

In view of the fact that the wreck of a well-braced iron or steel structure by wind is exceedingly rare, if, indeed, there is any previous record of such, the destruction of part of the so-called High Bridge over the Mississipi river at Smith avenue, St. Paul, Minn., is of special interest to the professional bridge engineer. This structure was designed supposedly to meet, with a reasonable factor of safety, the maximum wind loads required by a standard specification; and the utter destruction of a portion of it by wind pressure alone, in view of this supposed margin of safety, would lead to the presumption that the standard requirements do not produce a safe structure, unless it can be shown by reasonable computation that there was some weak joint or detail in the frame which would insure its destruction under the action of forces not materially greater than those which, nominally, it was designed to withstand.

The structure was built in 1887, according to general plans prepared by the City Engineering Department of St. Paul. Detailed drawings were made by the contractor, C. L. Strobel, M. Am. Soc. C. E., and the work was erected by Horace E. Horton, M. Am. Soc. C. E., of Chicago, Ill. The bridge is a deck structure of wrought iron, 2,770 ft. long and runs northwest and southeast. The northwest portion of the bridge is of the viaduct type, with riveted spans of 80 ft. and plate-girder tower spans of 40 ft. Four-leg towers alternate with two-leg bents. The portion of the viaduct over the river consists of four 250-ft. pin-connected deck spans of the subdivided Warren type, 30 ft. deep and 22 ft. from center to center of trusses. The floor beams are at 12 ft. 6 in. centers. The tower

*A paper presented at the meeting of the American Society of Civil Engineers, Dec. 7, 1904.

supporting the shore end of the southeast 250-ft. span has a base of 55 ft. transversely, and of 50 ft. longitudinally, and a height of 129 ft. from the top of the pier to the bottom chord of the truss. As these trusses were 30 ft. deep, the roadway at this point was 160 ft. above the pier and about 180 ft. above the water. From this tower toward the bluff there was one 170-ft. pin span and two 60-ft. plate-girder spans. These girder spans, the 150-ft. pin span, the supporting tower, and the 250-ft. pin span were overthrown.

The bridge carries a 25-ft. roadway and two 8-ft. walks. The flooring for the roadway consists of a sub-floor of 3¾-in. fir plank and a wearing floor 1¾ in. thick. The plank for the walks is 2¾-in. pine. The stringers are of steel, the roadway of nine lines of 12-in. built stringers; the flanges are each two L's, 2 by 2 by 5/16-in., with 5/16-in. webs. The stringers for the walks are 6-in. I's.

The trusses were designed for a live load of 80 lbs. for the roadway and for the walks of the 250-ft. spans, 90 lbs. for the 170-ft. span and 100 lbs. per sq. ft. for all shorter spans. The lateral bracing was designed for a pressure of 450 lbs. per lin. ft. of bridge, two-thirds of which was assumed to act on the loaded (upper) chord. The towers and bents were assumed to have a wind pressure of 150 lbs. per lin. ft. acting against them.

In addition to the top and bottom lateral systems, a fairly efficient system of sway rods was provided in the 250-ft. span, and all the details of the lateral and sway bracing seem to have been well worked out for the type of bracing used.

The 250-ft. span fell on its side, except at the end torn from its support on the two-leg bent (still standing), and this end was given a quarter twist in addition and fell or was blown a considerable distance from the tower. The plate-girder spans were pulled down the bank, and lay but little out of the line of the viaduct. The tower frame which was overthrown was badly twisted, and the position in which the columns fell, together with the manner in which the bolts were bent and broken, would seem to indicate that the end of the 250-ft. span resting on the two-leg bent was first pushed off its support, and that the wind, acting on the loose span with its 10,000 or 11,000 sq. ft. of exposed area (the planking was well fastened) and an extreme leverage of 250 ft., twisted from its base the tower bent supporting the other end, and the falling mass, in its descent, pulled the girder spans down the hill.

If the collapse occurred as outlined, a few figures on the twisting moment on the top of the tower may be interesting. Supposing the floor to be at such an angle to the wind that the effective pressure is, say, 10 lbs. per sq. ft., then the twisting moment $= 10 \times 10{,}000 \times 125$ ft. $= 12{,}500{,}000$ ft. lbs., an amount far in excess of the ultimate resistance of the tower.

The next point which would seem to invite attention is the detail of the connection of the end of the wrecked 250-ft. span to the two-leg bent, and the strength, or resistance of this connection to uplift and to lateral sliding of the shoe. There was a two-leg bent, similar to the one that supported the end of the wrecked span, nearer the other shore, and, as this seat was easily accessible by a trap in the floor, a suspended platform and an iron ladder leading down to the shoe, it was examined first. The end of the 250-ft. span corresponding to that which was wrecked was found to rest on a nest of eight rollers each about 2⅞ in. in diameter with the usual spacing bars on the sides. The only resistance to the lateral motion of the rollers was a bar riveted to the cap on each side and a recess in the shoe above, about ½ or ⅝ in. deep, as nearly as could be readily determined. Provision was made for a 1½-in. guard bolt on each side of the shoe, a hole was provided in the column cap and a long slot in the side of the shoe. No bolts, however, were in place.

The column cap from which the 250-ft. span slid off on the leeward side of the bridge was also examined. But one roller was left on the windward cap, while seven of the eight remained on the leeward cap. Careful examination showed that this span was anchored down somewhat better than the one referred to above, and instead of having no bolts at all, there was one on the outside of the windward shoe which was splintered and broken in place. The appearance of the other three holes was positive evidence that there were no bolts in any of them.

There is, then, the resistance of this end of the span, reduced to the dead weight, and the value of this bolt. If the wind tended to raise the windward truss, as it is pin-connected with the eye-bar bottom chord and diagonals, the truss would furnish little resistance to upward forces, and the bolt at the end, being a cantilever from 3½ to 4 in. from the center of the shoe plate to the center of the bearing in the cap, would not develop its shear value, but only its bending value, an insignificant amount of 3,000 or 4,000 lbs. or less. An uplift on the windward side would be accompanied by a reversal of stress in the bottom chord, the probable buckling of the chord, and, with the slight resistance of the bolt, the shoe would be pulled from the cap and the rollers displaced, and this was what actually happened.

A rough appoximate estimate of the weight of the span and floor would be in the neighborhood of 2,200 lbs. per lin. ft., giving a reaction of, roughly, 140,000 lbs. at each support. As the storm was a severe one, it will be assumed, for purposes of computation, that the very severe wind pressure of 30 lbs. per sq. ft. was acting at an upward angle to the floor of 30 deg., and the pressures will be calculated with Unwin's table.

Let a = Angle of surface with direction of wind;

F = Force of wind, in pounds per square foot (assumed at 30 lbs. per sq. ft.);

A = Pressure normal to surface $= F \sin. a^{1.84 \cos. a - 1}$;

C = Pressure parallel to direction of wind $= F \sin. a^{1.84 \cos. a}$.

For $a = 30$ deg., $A = 0.66$ and $C = 0.33$.

The direct uplift at each shoe $= 20.5 \times 125 \times 0.66 \times 30$ lbs. $= 50{,}100$ lbs. from the wind on the floor.

The overturning force, C, at each end of the bridge $= 0.33 \times 30$ lbs. $\times 41 \times 125 = 51{,}200$ lbs. from the wind on the floor.

The uplift from C on the windward shoe $= \frac{51{,}200 \times 30}{22} = 70{,}000$ lbs,

The direct pressure on the side of the truss top chord, approximately, $= 30 \times 7 = 210$ lbs. per lin. ft., and $\frac{210 \times 125 \times 30}{22} = 36{,}000$ lbs. the uplift from the same.

As the wind has been assumed to be blowing upward, this component on the vertical area would give an additional uplift of some 6,000 lbs.

Now, the sum of these computed uplifts is 162,100 lbs., or about 15 per cent. greater than the reaction due to weight. Evidently, if the windward shoe is raised, there being no bolts to hold down the leeward shoe, it would turn sufficiently for the recess in the shoe to clear the corner of the rolls and then slide off the cap. Allowing some slight resistance for the expansion connection of the stringers to the beam, it would seem safe to conclude that the wind pressure assumed is 10 per cent. greater than would have been necessary to cause the wreck. Rough computations on the laterals, taking into consideration the sway rods and the action of the four planes of bracing, would indicate that they were not strained much beyond 23,000 to 25,000 lbs. under the assumed forces.

Bearing in mind the fact that the floor is on a steep up grade, it may well be that the angle of action of the wind on the floor was greater than has been assumed, and, if so, the necessary pressure to cause the wreck might be considerably less than the 27 lbs. per sq. ft. calculated. Again, the probability is that the assumption of a uniform pressure is materially in error. Judging somewhat by the contour of the bluff and the path of the storm, it would seem likely that the maximum pressure was in the vicinity of the northwest end of the wrecked 250-ft. span, and that the adjoining span was saved by its rigid connection to the two-leg rocker bent. If the pressure were greater at the end, it is evident that the average pressure necessary to cause the wreck would be materially less.

Such moderate pressures as have been figured on, when their cumulative effect is concentrated upon a weak detail, may evidently produce results that cause astonishment, and the rash assumption, by those whose training should lend better judgment, that the pressures involved are "exceedingly great."

Evidently, whether dealing with bridges or roofs, stiff riveted construction, with bottom chords and diagonals capable of taking reverse stresses is to be preferred, and, in view of the fact that, by the exercise of reasonable skill in design, they can be fabricated for a sufficiently smaller cost than the pin type to offset the additional expense of riveting in the field, they should be preferred for all moderate spans, such as 250 ft. or less, unless the work is exceptionally heavy.

In the provision for temperature stress, the expensive and frequently weak details often worked out to avoid a harmless little amount of temperature strain, in an effort to eliminate it entirely, are indeed surprising; perfect double-action toggle connections are too often introduced at the shortest possible intervals, and dignified by the name of expansion joints. In the present instance, for example, an ordinary sliding plate fitted with a compression grease cup would probably move as easily as the badly rusted rolls on a rusty base and cap; while the guard bolts would be brought into actual shear and tension under forces tending to displace the shoe instead of inbending as with the detail adopted. From a careful examination of the 2½-in. anchor bolts of the windward column of the fixed bent under the 250-ft. span, it would seem that they were without nuts, though this fact appears to have no material influence on the wreck.

A Concrete Wall Eleven Years Old.

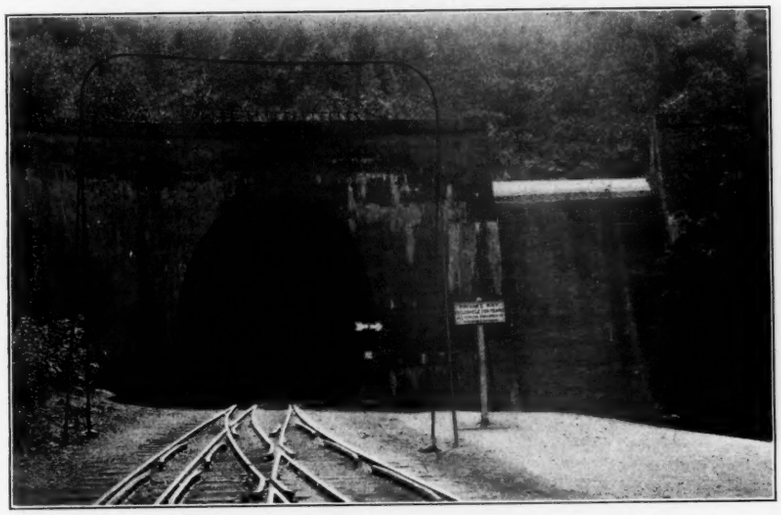
The photographic engraving shown herewith affords an interesting example of a durable concrete retaining wall, the structure having stood now eleven years and having shown no indication of cracks or signs of failure of any kind. It is a combined dam and tunnel portal, on the line of the Coast division of the Southern Pacific between Wright's and Laurel, 62 miles south of San Francisco, in the Santa Cruz mountains. The photograph has been sent to us by Mr. John D. Isaacs, Engineer of Bridges of the Southern Pacific, who, with the late W. G. Curtis, Engineer of Maintenance of Way, planned and carried out the work in 1893-4.

The tunnel is 1.16 miles long, and the portal is a short artificial tunnel joining the original tunnel where the latter enters the bedrock. As a result of the heavy rains in the winter of 1892-3 a landslide destroyed about 200 ft. of the tunnel at the north end, and

traffic was suspended for several months. At this place, a tributary to Los Gatos creek, which flows due east, is joined by a side creek flowing north. Both creeks are nearly dry in summer, but become torrents in stormy weather. The railroad track prior to the landslide crossed the side creek just at the mouth of the tunnel, and a few feet away from its junction with the north creek. At the time of the landslide the two creeks cut through the clay bed to the rock below, and the whole hillside, for some 300 feet back, slid forward toward Wright's station, filling the narrow throat between the points of rock at the tunnel portal. The entire mass seemed to be afloat on a film of water between the clay and bedrock, and the first 200 feet of tunnel was completely crushed in and taken with the slide. Numerous attempts to reconstruct the end of the tunnel and portal with heavy timber and iron all proved absolute failures. It was evident that the next winter would again bring trouble, so after much discussion it was finally resolved to re-establish and maintain the toe of the slide by raising the beds of the two creeks, and by constructing a concrete masonry retaining-wall or dam from the rock points, across the mouth of the tunnel. Accordingly a concrete retaining-wall was built, pierced by a tunnel running into and forming a part of the tunnel proper. The toe of the slide in question was re-established by filling in the beds of the two creeks, and by carrying the side creek from the south, behind the wall over the top of the tunnel and making it join Los Gatos creek at a spillway in the westerly side of the retaining-wall. Through this spillway the combined streams now discharge. The retaining-wall is about 28 ft. high from base of rail, 14 ft. thick at bottom and 2 ft. thick at the top. The tunnel through the same is oval in shape, and of varying thickness. To avoid hydrostatic pressure on the retaining-wall, it was backed by rubble masonry, covered with clay puddle, well rammed; and separate drains were run from the rubble and from the slide behind it through the retaining-wall. The same arrangement was followed with the masonry tunnel. As the tunnel cut through the slide it had to be arranged to transmit the thrust of the slide from south to north. The sides of the barrel were therefore carried down to bedrock, and a key-piece put in under the track. The earth was well tamped and rammed on both sides of the barrel, and the top of the tunnel was loaded with earth from 15 ft. deep, at a point 42 ft. back from the retaining-wall, to 25 ft. deep at its further end. In effect, the barrel was made part of the slide, and the slide provided with a toe.

The masonry is a concrete monolith, and all the concrete is mixed in the following proportion, by volume: One part Portland cement, two parts sand, three parts gravel and four parts rock broken small enough to pass through a 2-in. ring. All of that portion below the base of rail, except the key-piece under the track, has placed in it large pieces of rock varying from one-quarter to one cubic yard, as follows: A layer of concrete, 6 in. thick, having been first laid, and while yet soft, large rocks were placed upon it, with their best bed down, the rocks usually standing on one of their ends, leaving a clear space of about 18 in. between them, into which the concrete was afterwards rammed until the spaces were filled. Smaller stones were thrown in whenever room permitted, and rammed with the filling, but care was always taken to surround all rock with concrete. By placing the large stones smaller side down, it was thought that they would bed themselves better in the soft concrete. This method was carried out until the height of base of rail was reached; above that the same concrete mixture was used minus the large stones. The rock is a strong heavy blue trap, taken from the side of the road nearby. About one month was required for putting in the concrete. Segments and lagging were made of 2-in. plank; falsework, of 12 in. x 12 in timber. The tunnel is made large enough for a standard gage track. The entire wall, including the dam, contains about 108,000 cu. ft. of concrete. The falsework was allowed to remain in position during the winter of 1893-4, but was removed the following summer. The main point for engineering consideration regarding this work is, that it is now eleven years since the wall was built, and up to the present time the structure shows absolutely no indications of cracks or other sign of failure, and is apparently solid and good for all time. The white matter on the face of the wall in the photograph is the lime emission, not water or ice, as might be supposed.

We are indebted to John D. Isaacs, Engineer of Bridges on the Southern Pacific, for the above data.



A Concrete Portal and Spillway Eleven Years Old.

The President on Railroad Questions.*

Employers' Liability Law.—The wage-workers are peculiarly entitled to the protection and the encouragement of the law. From the very nature of their occupation railroad men, for instance, are liable to be maimed in doing the legitimate work of their profession, unless the railroad companies are required by law to make ample provision for their safety. The Administration has been zealous in enforcing the existing law for this purpose. That law should be amended and strengthened. Wherever the national Government has power there should be a stringent employers' liability law, which should apply to the Government itself where the Government is an employer of labor. . . . I recommend that the Congress appoint a commission to make a comprehensive study of employers' liability, with the view of extending the provisions of a great and constitutional law to all employments within the scope of Federal power.

Medals of Honor.—The Government has recognized herosim upon the water, and bestows medals of honor upon those persons who by extreme and heroic daring have endangered their lives in saving, or endeavoring to save, lives from the perils of the sea. This recognition should be extended to cover cases of conspicuous bravery and self-sacrifice in the saving of life in private employments under the jurisdiction of the United States, and particularly in the land commerce of the nation.

Prevention of Accidents.—The ever-increasing casualty list upon our railroads is a matter of grave public concern, and urgently calls for action by the Congress. In the matter of speed and comfort of railway travel our railroads give at least as good service as those of any other nation, and there is no reason why this service should not also be as safe as human ingenuity can make it. Many of our leading roads have been foremost in the adoption of the most approved safeguards for the protection of travelers and employees, yet the list of clearly avoidable accidents continues unduly large. The passage of a law requiring the adoption of a block-signal system has been proposed to the Congress. I earnestly concur in that recommendation, and would also point out to the Congress the urgent need of legislation in the interest of the public safety limiting the hours of labor for railroad employees in train service upon railroads engaged in interstate commerce, and providing that only trained and experienced persons be employed in positions of responsibility connected with the operation of trains. Of course nothing can ever prevent accidents caused by human weakness or misconduct; and there should be drastic punishment for any railroad employee, whether officer or man, who by issuance of wrong orders or by disobedience of orders causes disaster. The law of 1901, requiring interstate railroads to make monthly reports of all accidents to passengers and employees on duty, should also be amended so as to empower the Government to make a personal investigation, through proper officers, of all accidents involving loss of life which seem to require investigation, with a requirement that the results of such investigation be made public. The Safety Appliance law has proved beneficial to railway employees, and the force of inspectors provided for by appropriation should be largely increased. This service has passed the experimental stage and demonstrated its utility, and should receive generous recognition by the Congress.

Freight Rates.—We must strive to keep the highways of commerce open to all on equal terms; and to do this it is necessary to put a complete stop to all rebates. Whether the shipper or the railroad is to blame makes no difference; the rebate must be stopped, the abuses of the private car and private terminal track and side-track systems

*Extracts from the annual message to Congress of President Theodore Roosevelt.

must be stopped, and the law which declares it to be unlawful for any person or corporation to offer, grant, give, solicit, accept, or receive any rebate, concession, or discrimination . . . must be enforced. . . . As the law now stands the commission simply possess the bare power to denounce a particular rate as unreasonable. While I am of the opinion that at present it would be undesirable, if it were not impracticable, finally to clothe the commission with general authority to fix railroad rates, I do believe that, as a fair security to shippers, the commission should be vested with the power, where a given rate has been challenged and after full hearing found to be unreasonable, to decide, subject to judicial review, what shall be a reasonable rate to take its place; the ruling of the commission to take effect immediately, and to obtain unless and until it is reversed by the court of review. The Government must in increasing degree supervise and regulate the workings of the railroads engaged in interstate commerce, and such increased supervision is the only alternative to an increase of the present evils on the one hand or a still more radical policy on the other. In my judgment the most important legislative act now needed as regards the regulation of corporations is this act to confer on the Interstate Commerce Commission the power to revise rates and regulations, the revised rate to at once go into effect, and to stay in effect unless and until the court of review reverses it.

Steamship companies engaged in interstate commerce and protected in our coastwise trade, should be held to a strict observance of the interstate commerce act.

Railroad Shop Tools.

(Continued.)

LOCOMOTIVE FRAME DRILL.

The four-spindle lomocotive frame drill, Fig. 1, is made by the Niles-Bement-Pond Company, New York. Each head is driven by an independent motor, thus making it possible to drive each drill at its most economical speed. The speed range is obtained by gearing and by field control in the motors. The spindle heads are mounted on arms projecting from the cross-rail and have an in-and-out adjustment of 20 in. The arms can also be adjusted along the cross-rail so that when a locomotive frame is once clamped, holes may be drilled in any position. One of the heads is arranged to swivel so that work may be drilled at any angle. The spindles are counterweighted and have variable power feeds.

The maximum distance between the spindles is 24 ft. The spindles have a 20-in. traverse, six positive gear feeds and speeds from 15 to 250 revolutions per minute. The swiveling saddle has an adjustment in-and-out from the cross-rail of 16 in., and the plain saddles an adjustment of 20 in. The table is 26 ft. long and the top and vertical faces have T slots for holding frames in a horizontal plane.

The motors are of 5 h.p. capacity and have

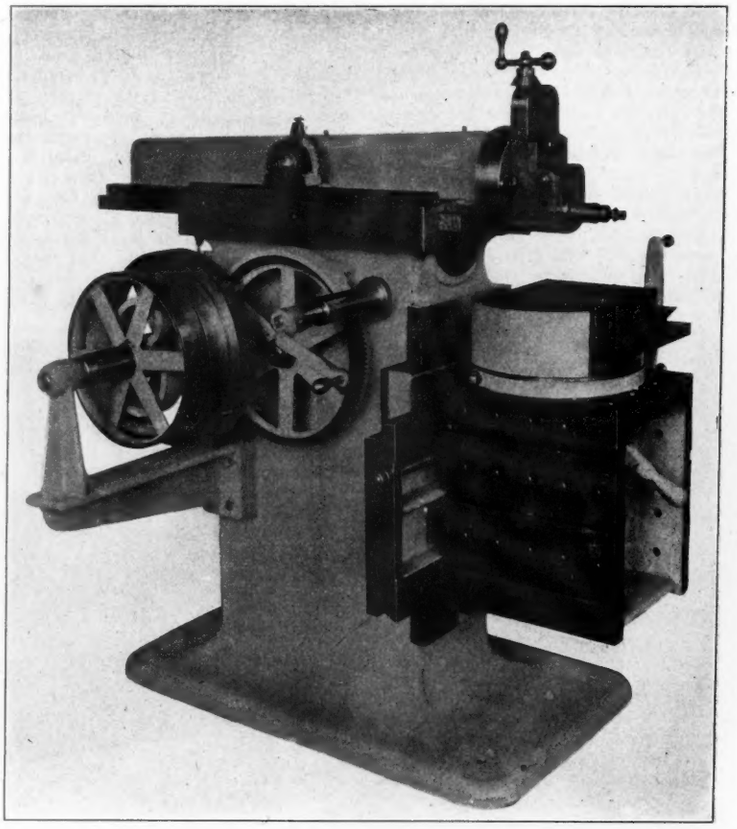


Fig. 2—The Hendey 24-in. Shaper.

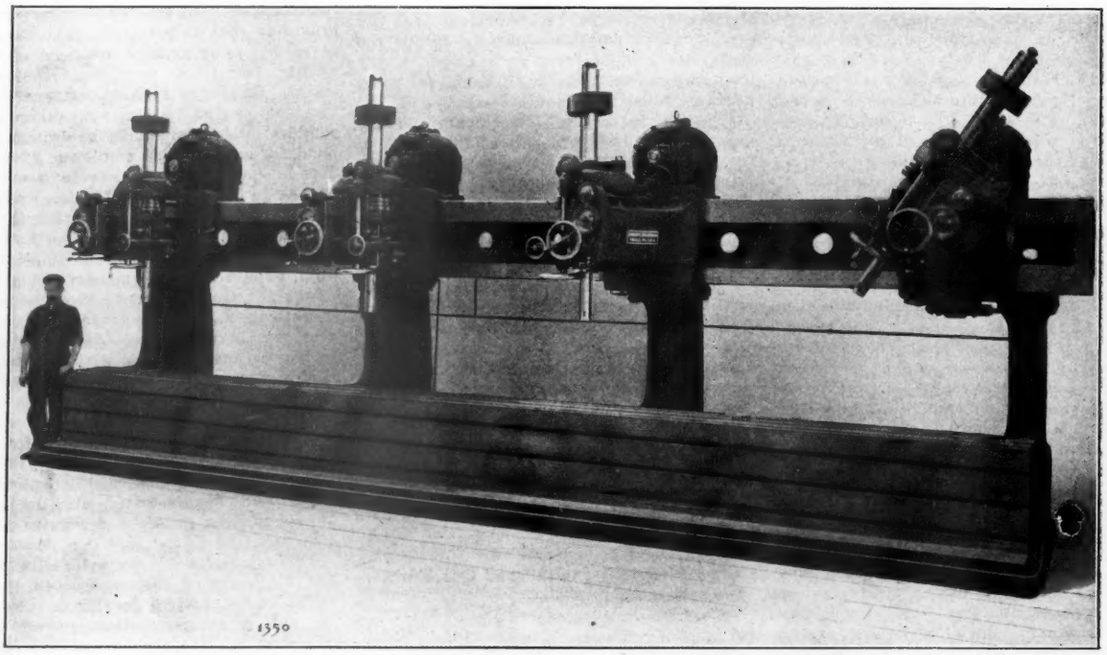


Fig. 1—Niles-Bement-Pond 4-Spindle Locomotive Frame Drill.

a speed range of 1 to 2 by field control. The machine illustrated was built for the Canadian Pacific Railway.

SHAPING MACHINES.

For planing small pieces the shaping machine is much quicker and easier to handle than the planer, and aside from this it takes less floor space, and when fitted with tilting table, swivel vise, index centers and a cone mandrel having a power rotary motion this type of machine may be used to advantage for a great many special purposes. In the ordinary pillar shaping machines the work is fed under the tool by movement of the table. In the traverse or traveling-head shaping machines the cutter bar is carried in the head which travels along the bed. The head is usually supplied with both hand adjustment and variable power feed. The traveling head shaping machines are made with either one or two heads and as a rule the cutter bars in all types of shapers have quick return and are adjustable for any length or position of stroke. The tool slides have a vertical adjustment, and swivel to any angle.

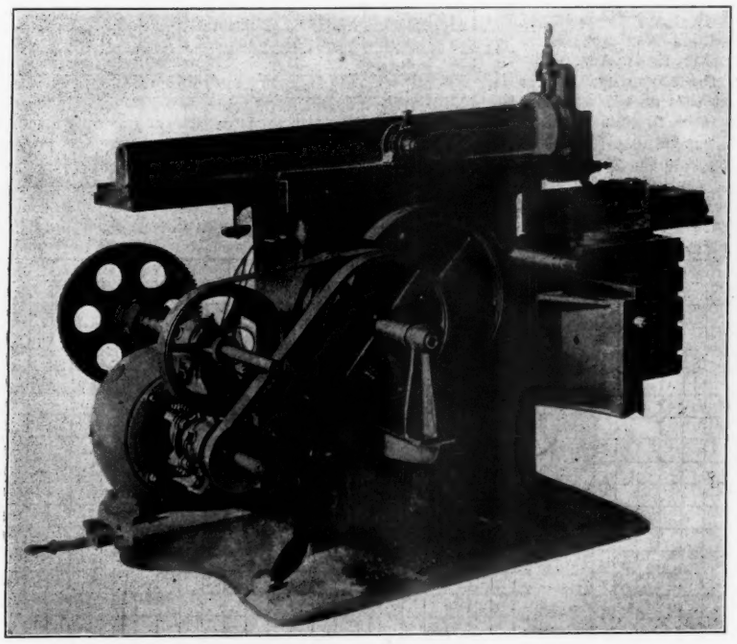


Fig. 3—The Hendey 24-in. Shaper.

The 24-in. pillar shaper shown in Fig. 2 is made by the Hendey Machine Company, Torrington, Conn. It is suitable for both light and heavy work, has a stroke of 24 in., and will plane work 17 in high. A cross feed of 23 in. is provided for the table and the tool has a vertical adjustment of 5 in. The minimum stroke at which the machine will reverse and feed is ½ in. The cutting speed is uniform through the entire stroke. The feed mechanism and the dogs for changing the length of stroke are easily accessible and can be adjusted by the operator from his position in front of the machine. Automatic, horizontal, vertical and angular feeds are provided and there is a space under the cutter bar large enough to admit the passing through of a piece of work 3¼ in. in diameter. This will be found useful when cutting key seats and other work of like nature. The table is a solid casting 16½ in. x 12 in. It has bolt slots ¾ in. wide on each side as well as on the top. The driving shaft has an extra outside support, which relieves the bearings of all undue strain. The vise swings in a ring; it is graduated and has steel-faced jaws, and will take in work 9½ in. wide. The tool post of this machine will take a tool ⅝ in. x 1¼ in. The size of the tight and loose pulleys on the countershaft is 12 in. x 3¼ in., and they should run at 225 r.p.m. The weight of the machine is 2,470 lbs. The method of applying an individual motor drive to the machine is shown in Fig. 3. The motor used is of the back-geared type and it is belted direct from the high-geared commutator shaft to the reversing pulley of the shaper. The motor is run at constant speed and changes of speeds for the cutting stroke of the ram are obtained by means of the two-step cone pulley on the shaper and back gear shafts. The bracket carrying the motor is bolted to the rear of the shaper base as shown. It has a sliding plate upon which the motor is mounted and which affords a quick means of tightening the belts. This method of mounting the motor practically takes no additional working space as the ram at its full return stroke overhangs the motor and bracket at the rear.

These shapers are made in four sizes, as follows: 15 in., 20 in., 24 in. and 28 in. respectively. A one h.p. motor is required to drive the 15-in., 2 h.p. for the 20 and 24-in. and a 3 h.p. for the 28-in.

The 25-in. back geared crank shaper shown in Fig. 4 is made by The John Steptoe Shaper Company, Cincinnati, Ohio. This machine can be operated either as a single-geared or a back-geared shaper; changes from one run of gears to the other are made by a lever in the back of the machine and within easy reach of the operator. There are 10 changes of cutting speed to the ram and the ram has a bearing in the column of 36 in. An opening under the ram admits shafts up to 3½ in. in diameter. The stroke of the ram can be changed or adjusted while the machine is in motion and a graduated index which shows the length of the stroke the machine is taking, is attached to the top of the column. The head is graduated and can be loosened and swiveled to any angle, by pushing the lever at the back of the head and can again be fastened by pulling the lever towards the operator. This will be found an improvement over the method of fastening the head with bolts, as it saves the time of the operator looking for wrenches and the time of opening and fastening the bolts. The top of the table is 16 in. x 25 in. It is slotted on all three sides and can be readily removed, allowing work to be fastened to the slotted apron to which the table is attached. An outer support is attached to the bottom of the table; it can be removed when desired and is provided with a screw adjustment, locknut and swivel base which slides freely along the planed surface on the base of the machine. The table has an automatic cross feed of 27½ in. and a vertical adjustment of 14 in. A 9-in. feed is provided for the tool block. All feeds are automatic and can be changed while the machine is in motion. The vise is graduated and will swivel to any angle. The steel-faced jaws are 2¼ in. deep x 12 in. wide, and have a maximum opening of 15 in. The cone-pulley has five steps for a 3¼ in. belt. The tight and loose pulleys on the countershaft are 14 in. in diameter for a 4 in. belt and should run at 125 r.p.m.

(To be Continued.)

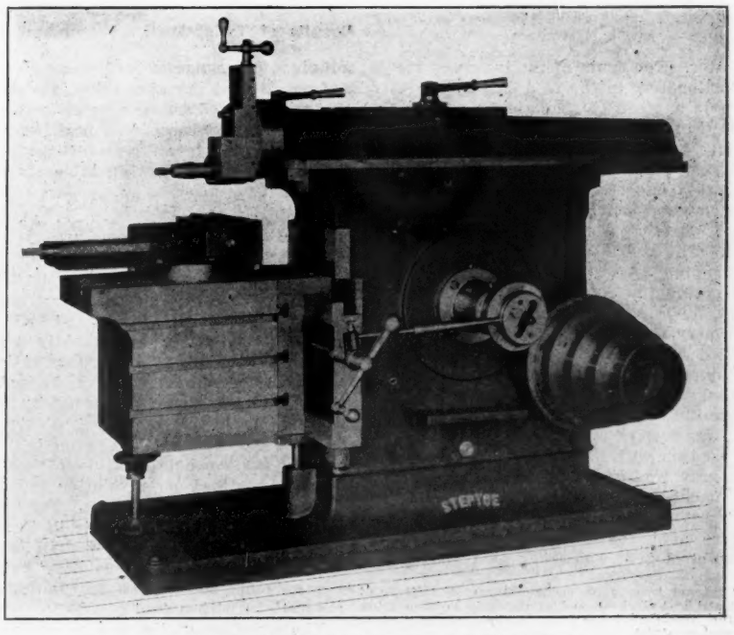


Fig. 4—The Steptoe Back-Geared Crank Shaper.

A Twist Drill Dynamometer.*

The introduction of the high-speed twist drill into modern machine shop practice has brought with it many new problems, and to supply some of the data necessary for their solution the machine which is the subject of this paper was designed and constructed. It was taken as a thesis subject by Mr. George F. Read, Jr., of the class of 1904 at the Worcester Polytechnic Institute, and some of the preliminary work was done by him. All the experiments here reported, however, were conducted by the authors at the Washburn shops of the institute.

The machine is really a double dynamometer, measuring the twist or moment and the thrust of the drill. It consists of a chuck with trunnions, mounted or roller bearings so that it is free to revolve about its axis at the same time it is free to move in the direction of its axis, being mounted on a carriage which is on rolls resting on the frame of the machine. This frame was placed on the table of a milling machine so that the axis coincided with the center line of the drill, which was driven by the spindle of the milling machine. The thrust of the drill is transmitted through the trunnion of the chuck to a plunger which is fitted into a long cylinder filled with oil. At the end of this cylinder is a smaller one also carrying a plunger. This small plunger is attached to a ball-bearing piston in a regular indicator. The drum of the indicator moves proportionately to the feed so that the card taken is a record of the thrust during the drilling of a hole. The chuck is held from turning by a steel band which is attached by a yoke to a second indicator, and a card from this one shows the twisting moment at each stage of the operation. Both indicators were calibrated before and after the tests. The correct moments were obtained by hanging known weights over the chuck and noting the rise and fall of the pencil point. The thrust cylinder was placed in an Emery testing machine and known loads applied and a corresponding record taken on the cards. From these tests, curves were plotted so that readings from the cards could be readily reduced to pounds.

It was decided to take up first the drilling of cast iron with high-speed steel. Blocks of soft gray iron were obtained and tested in the machine itself so as to get a number for each set of experiments as near the same degree of hardness as possible. A ⅝-in. Novo steel drill was taken as a good representative of the new steels. The first experiments were on the effect of speed or number of revolutions per minute, all other conditions remaining the same. The revolutions were varied, from 140 to 600, but no material difference was shown by the cards in either thrust or twist. In other words, the power required to turn the drill varies directly with the number of revolutions, while the thrust does not increase with the speed, but depends upon the feed or the advance per revolution.

The next set of experiments was made to determine the relation between thrust and feed, the revolutions per minute remaining constant. From the first set of experiments it was shown that the limit of speed would depend upon the endurance of the drill, and with heavy feeds 420 revolutions was not far from this limit. Accordingly the second set was run at this speed, which for a ⅝-in. drill is about 70 ft. per minute for the cutting rate for the outer edges and for .020-in. feed a rate of drilling of about 8 in. per minute. The range of feed was taken from .004 to .020 in. per revolution, the drill at the coarsest feed being somewhere near its limit. These feeds were all positive, a train of gears being substituted for the regular belt drive. The following table shows the results:

Table 1.

Feed, in.†	.004	.006	.008	.010	.012	.014	.016	.018	.020
Thrust,‡	240	280	330	360	410	460	525	620	725
Moment§	55	67	83	92	103	115	124	132	138

†Per revolution. ‡Total in lbs. §Total in in.-lbs.

Fig. 1 gives the same data for thrust and feed in the form of a curve and shows that the thrust increases very rapidly with the coarser feeds. Fig. 2 is a curve giving the relation between moment and feed, and shows that the moment does not increase at the same rate as the thrust. This would seem to indicate that less power is required to drill a given hole in a given time by increasing the feed per revolution rather than by increasing the revolutions. For example, to drill a hole in a 1-in. plate in 10 seconds could be done by running the drill 600 r.p.m. and feeding .010 in. per revolution, but would require more power than by running at 300 revolutions with a feed of .020 in.

The question of the proper angle of the drill was next considered, and a set of experiments made with a constant speed and feed, the half-angle varying from 37 deg. to 70 deg., 22 deg. less and 11 deg. more than the standard 59 deg. The following table shows the results:

Table 2.

Angle of drill, degs	37	45	50	55	59	65	70
Thrust in lbs.	215	225	240	260	290	325	375

Fig. 3 is a curve for the same and shows that the thrust would be decreased by having more of a point on the drill. With an angle of 37 deg., however, the drill would not stand up on repeated work. At 45 deg. it seems to do the work as well as at 59 deg. and with much less thrust. This would suggest a change in the standard angle for the new steels. The moment for the various angles remained practically constant, so that the driving power does not change with the angles of the drill.

Another interesting point in drilling which was shown with this machine is the effect of first removing the center of a hole by the use of a small drill. Ten holes were drilled in a bar of cast iron with small drills, ranging from No. 53 to ½ in. in diameter and then each one counterbored with a ⅝-in. drill at 420 r.p.m. and a feed of .008 in. per revolution.

Table 3 gives the thrust in each case and shows that a hole $^1/_{10}$ in. in diameter takes off about one-half the thrust for a ⅝-in. drill.

Table 3.

Size of first hole:	.000	.0595	.076	.0935	.120	.157	.189	.221	.250	.375	.50
Thrust for counterbore:	340	190	180	170	155	145	130	120	90	70	30

The range of experiments is almost limitless, and to cover the entire field for feed,

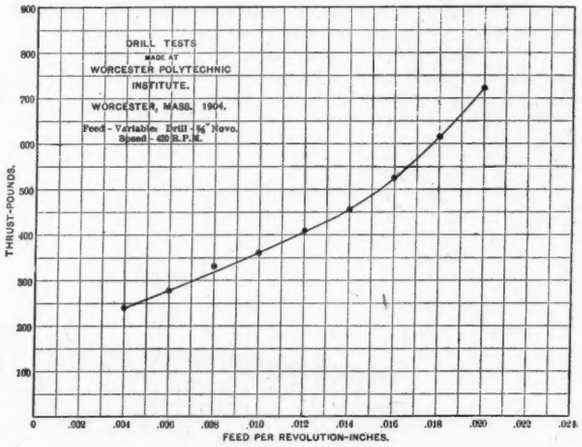


Fig. 1.

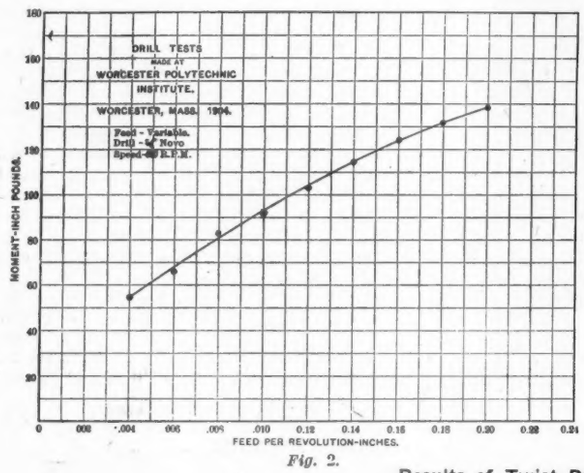


Fig. 2.

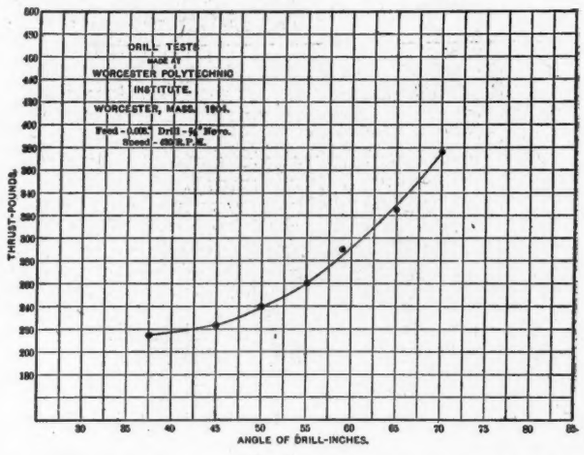


Fig. 3.

Results of Twist Drill Dynamometer Test.

*Extract from a paper by William W. Bird and Howard P. Fairchild read at the New York meeting of the American Society of Mechanical Engineers, December, 1904.

speed, angle of drill, etc., for various materials and all kinds and sizes of drills will require much time and many tests. Some of the data so far acquired are here reported with the hope that others may add to it, as well as suggesting lines for further experiments.

Pro-Rating with Shippers' Railroads.

The decision of the Interstate Commerce Commission concerning the excessive divisions allowed by certain railroads in Chicago to short industrial railroads owned by large manufacturers, holding that such divisions are unlawful, was given in the *Railroad Gazette* of November 18 (page 156, News Section). From the full text of the report, which is now at hand, we quote the following paragraphs, in which the reasoning of the decision is more fully set forth.

The vice in the present case is to be found in the thing done, not in the manner of doing it. A cardinal purpose of the Act to regulate commerce is to prohibit all preference between shippers, and the framers of that Act and its amendments have evidently attempted to make the language sufficiently comprehensive to render every sort of preference, by whatever means attempted, unlawful. The second section of the original Act provides that no greater compensation shall be collected of one shipper than of another "by any special rate, rabate, drawback, or other device." The third section provides that it shall be unlawful for a common carrier subject to the Act to grant any undue preference to any individual or any specie of traffic "in any respect whatsoever." The amendment of the Act, approved February 19, 1903, commonly known as the Elkins Bill, requires carriers in all cases to publish their tariffs, and prohibits, under severe penalty, any practice upon the part of the carrier "whereby any such property shall, by any device whatever, be transported at a less rate than that named in the tariff, * * * or *whereby any other advantage is given or discrimination is practiced.*"

We think these divisions, if not in violation of the express language of the second section of the original Act, are plainly within the prohibiton of the Elkins Bill. When the Santa Fe pays to the Illinois Central $12 for moving a car loaded with the traffic of the International Harvester Company from the McCormack works to its Corwith yard, a service for the performance of which $3 is a reasonable compensation, which was never exceeded previous to January 1, 1904; and when it does this in order to obtain the traffic of the International Harvester Company, it thereby grants that company in effect a rebate of $9 upon that carload of freight. It certainly is guilty of an act by which an advantage is given and a discrimination is produced in favor of the International Harvester Company. The manifest intention of the Act to regulate commerce, especially as expressed in the Elkins amendments, is to strike through all pretense, all ingenious device, to the substance of the transaction itself; and where excessive divisions of rates are granted by a carrier to another carrier owned and controlled by a shipper, for the purpose of obtaining the traffic of that shipper, they benefit the shipper and operate as a rebate or other device to cut the tariff charge in violation of the law.

It is urged that all this is simply an arrangement betwen two connecting railroads; that there is no negotiation with the shipper, and no payment to the shipper. This is a mere play upon words. The Illinois Northern Railroad Company and the International Harvester Company are one and the same thing. It is entirely immaterial whether this money goes in the first instance into the treasury of the International Harvester Company or that of its creature, the Illinois Northern Railroad Company. That subterfuges of this sort cannot avail has been often decided, and was affirmed within the year by the Supreme Court of the United States in Interstate Commerce Commision v. Baird, 194 U. S. 25, 48 L. ed. 860, 24 Sup. Ct. Rep. 563, in which it was held that it made no difference whether certain contracts were entered into with a railroad company itself or with a coal company the stock of which was entirely owned by the railroad company.

The Chicago, Lake Shore & Eastern, as found, is the creature of the United States Steel Corporation. The questions presented by its operations differ from those already discussed, chiefly in that the practices are of longer continuance and of wider scope. The International Harvester Company, through the medium of its railroads, obtains no divisions whatever from eastern lines; but the United States Steel Corporation, with its greater power, has been able to force from eastern connections divisions on all business. The International Harvester Company has not yet been able to compel the railroads which handle its traffic to maintain its tracks or perform its switching service within its iron working plant at South Chicago; but the Illinois Steel Company has for the last eight years obtained from the railways transporting its traffic compensation for the maintenance and operation of the miles of track which are located within its private works. In this respect the Steel Trust, to use the popular expression, is as far in advance of the Harvester Trust as the latter company is ahead of the ordinary shipper.

The Block System on the Vandalia Line.*

About two and one-half years ago our freight traffic became very heavy and we found that on certain portions of our road we were moving 70 trains a day. Between Indianapolis and Terre Haute, 73 miles, with two coal mine districts, traffic is always heavy. We found that we were moving as much traffic as certain double-track lines, though we had not one inch of double-track, even in the yards. All of a sudden, hardships began to rain on us thick and fast. The good luck with which the Vandalia Line is credited, seemed to have left us entirely; our oldest and best conductors and enginemen forgot their orders and overlooked trains of superior right, and with very disastrous results. In one case an operator failed to deliver an order and caused one of the greatest disasters the Vandalia Line has ever seen in the way of a collision.

Things got into bad shape. Enginemen seemed over-cautious and passenger trains lost time. Engine failures became numerous and side tracks and yards were packed with cars. The train despatchers became discouraged because they were unable to keep up with their work. Finally it was decided at least to put an end to the collisions, and the use of the block system on a number of other roads was investigated.

Mr. Davis then goes on to describe what he found on the Chicago & Alton, the Cincinnati, New Orleans & Texas Pacific, the Chicago, Milwaukee & St. Paul and the Philadelphia & Reading. On those parts of the Alton where automatic signals are used, the switches have audible indicators. On all Alton passenger trains a speeder (three-wheel velocipede hand-car) is carried, and whenever a train is stopped by a signal the flagman immediately goes ahead on the speeder and the train follows a safe distance behind at the rate of 15 miles an hour.

The C., N. O. & T. P. also has audible indicators and uses the Alton method of flagging. "Now and then the flagmen will meet on their speeders, shake hands and compare orders, and find that someone has made a pretty serious error." The officers of the company are of the opinion that the automatic signals have saved for their company many times their cost by the prevention of collisions.

On the C., M. & St. P. Mr. Davis found blinders over the lights in signals for a diverging route, which does away with running enginemen against red lights when the main line is clear. The Philadelphia & Reading has manual block signals in only one place; this is at a gauntlet over a bridge. With automatic signals the Reading uses a visual indicator at switches. For train orders a small semaphore is used, and it is so connected with the nearest automatic (disk) block signal that when put on it causes the latter to indicate caution.

Mr. Davis then briefly described the signaling on the single-track line crossing the Louisville bridge between Louisville, Ky., and New Albany, Ind., which has been in use 22 years (described in the *Railroad Gazette* of Feb. 19, 1886). During this time there has been no failure of any kind on account of the method of blocking. In one day of 24 hours 225 trains have been handled. On this short single-track line all signals are given on orders from a single train despatcher, who, besides his train sheet, has a graphic record in the shape of a board, with plugs stuck in holes to indicate trains. Except in one crooked block (No. 4) trains are run under permissive signals, when necessary.

On the Nashville, Chattanooga & St. Louis, where the block system is in use for six miles, between Chattanooga and Wauhatchie, the clearing of a signal causes a red disk to drop in front of the operators at both ends of the block section which is thus cleared. If, while this disk is visible, either operator attempts to admit another train, he sounds an alarm bell, warning him of his mistake. Mr. Davis speaks well of the block signaling on the Erie lines in Ohio, where all movements of the block operators are directed by the train despatchers, the despatchers having their territories made very short in order to permit this. Train orders, train rights and train rules prevail, however, just the same as though no block system existed. Here is used the Mozier apparatus for cutting out the telegraph key during the time that the signal is clear, so that the operator cannot accept new orders from the despatcher. Mr. Davis went on to describe the practice on a number other roads, and mentioned the apparatus lately put in use on the Illinois Central between Belleville and Corbondale, Ill., and between Paducah and Central City, Ky. With this apparatus, made by the General Railway Signal Company, the operators at the opposite ends of a block control each other, but the signals are not controlled by the trains.

The Vandalia did not feel able to put in automatic block signals, and so the manual block system was adopted. It is worked according to the rules prescribed by the American Railway Association. Signal towers were erected at suitable places, and as fast as four or five of these were completed Mr. Davis instructed the operators in the method of signaling. By connecting one wire to a number of offices he could sit at a central office and watch the work of the several operators. Three-position semaphore signals are used.

Before the work of installation was entire-

*Abstract of an address delivered before the St. Louis Railway Club, Nov. 12, by John L. Davis, Division Operator and Chief Train Despatcher, Vandalia Line.

ly completed there was noticeable a great difference in the movement of trains; it seemed the men realized all at once that they were protected, and faster time resulted from that time on. Our overtime began to decrease and continues to decrease. During the months of August and September of this year we decreased our overtime to the extent of fifteen hundred dollars each month, as compared with the same months of last year. The actual figures taken from our train sheets show that the number of freight trains handled in the six months, ending with September 30, 1904, decreased 301 over the corresponding period of last year. At the same time, the number of passenger trains run increased 923 (from 2,627 to 3,560). With that enormous increase in passenger traffic, it would only be reasonable to expect slower movement on a single track road, but the movement of our freight trains and the movement of our passenger trains has been accelerated to a remarkable degree.

It is proper to say, however, that this is not entirely due to the introduction of block signals, as three miles of double track was laid at Terre Haute, 2½ miles at Indianapolis and 10.8 miles entering East St. Louis. Mr. Davis, however, says that the second track can have full credit and still leave enough glory for the block system; and he recommends it for use "on nearly any single track railroad in existence."

In closing, Mr. Davis reminded his hearers that the fact that numerous collisions occurred before the block system was adopted did not necessarily mean the worst record in the world; and he said that the only paying passenger ever killed on the Vandalia by a train accident, in its half century of existence, was one killed in 1895 in a derailment due to a broken rail. He thinks that the manual block system will be much more popular, for single track lines, than the automatic, for the reason that the operators are useful in handling the trains. A competent operator at each important side track means frequent saving of time for freight trains, which may amount to hours when the time of the whole of a trip is considered.

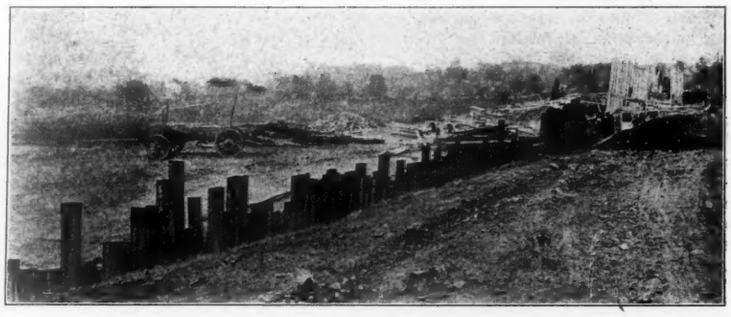
The reports of the traffic and extension of the Russian railroads in the first half of 1904 indicate much less disturbance by the war than might have been expected. The length worked was indeed 2,183 miles (nearly 6 per cent.) more than in 1903, and amounted to a total of nearly 40,000 miles, this including the Finnish and Manchurian as well as the Russian lines. Moreover, nearly 4,400 miles were under construction this year, which is 330 miles more than last year. The gross earnings of all the railroads increased a little more than 1 per cent., but there were great differences on different lines, the St. Petersburg & Moscow road, the greatest of Russian trunk lines, having a decrease of no less than 12 per cent. There was a decrease of more than 3 per cent. on the Siberian Railroad, and a large increase on the Asiatic Midland.

Friestedt Steel Sheet Piling.

Open-cut sinking for foundation excavations has always been considered the safest and cheapest method possible to adopt. But in most every case where depths exceeding 50 ft. had to be reached, it was impracticable, owing to the instability of wood sheeting as a retaining, as well as a driving, device. Where quicksand, coarse gravel, hard-pan, small boulders or loose wreckage was encountered, wood sheeting could not be used on account of lack of penetration and impossibility to interlock the joints. The tongue-and-groove joints were inadequate and gave an imperfect alinement of the sheeting, leaving a loosely fitting joint through which water or quicksand could pass. This, and the constantly increasing cost of timber in lengths sufficient to make sheeting of the proper dimensions, became a cause of some concern to engineers and contractors, and a substitute for the wood sheeting was in demand. Of course, there remained the alternative method of the pneumatic caisson, but this is an expensive device, with its equipment of bulkheads, air system, etc.

It was in response to this demand that interlocking steel sheet piling first made its appearance. One of the earliest as well as most successful of the designs of this type of piling is the Friestedt system, and the accompanying illustrations show some of the varied uses to which it has been, and is being, put. One of the largest and most important applications was the construction of the cofferdam for the foundation of the power station of the Union Electric Light & Power Company on the Mississippi River at St. Louis. This dam was 360 ft. long, 40 ft. wide and 50 ft. deep. It is understood that the steel piling was resorted to after other methods had failed.

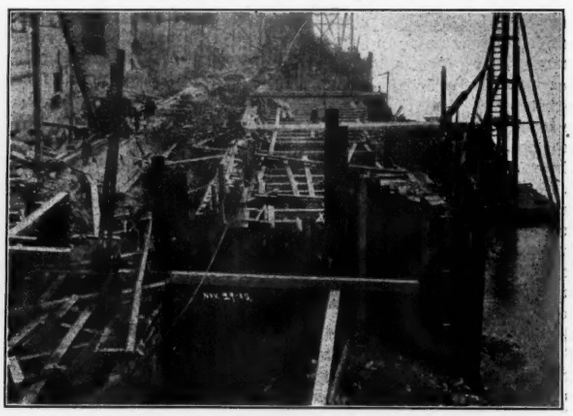
An equally interesting application was in connection with the construction of a 30-ft. core wall across the Hackensack River to form a reservoir for the Hackensack Water Company at Hillsdale Manor, N. J. The piling was driven to stop an underground flow through boulders and coarse gravel. The line of piping was 1,600 ft. long, 50 ft. lengths being used. A concrete retaining wall was built on top of and enclosing the piling. The engraving shows a part of the line, the irregularity of the tops being due to the fact that each pile was driven "until refusal."



Interlocking Piling Driven to Stop Leaks in a Reservoir Core Wall.

A nice piece of driving is shown in the illustration of the foundation work for Marshall Field & Company's warehouse in Chicago. Eight of these caissons were sunk, the size being 5 ft. 7 in. square by 40 ft. deep. Several railroads are making use of the piling, including the Burlington, the Missouri, Kansas & Texas and the Louisville & Nashville. The cofferdam construction used by the Burlington for the Cuivre River bridge on the Old Monroe-Mexico Cut-Off, described in our issue of the 2d inst., is included in the illustrations. The United States, Great Britain and the Dominion of Canada have adopted this piling in government work, and it was recently specified for over 1½ miles of breakwater construction shortly to be begun in the harbors of Toronto and Hamilton, Ontario. The Friestedt Interlocking Channel Bar Company has its office at 1410 Tribune Building, Chicago.

Interlocking Channel Foundation Caisson.



Cofferdam 360 ft. Long Built of Interlocking Channel Piling.

GENERAL NEWS SECTION

THE SCRAP HEAP.

The Baltimore & Ohio has re-established its press bureau, with headquarters at Baltimore. It is in charge of Mr. J. H. Maddy, who was at the head of the original bureau.

The Supreme Court of Virginia has sustained a rule of the State Corporation Commission fixing at 25 cents the rate to be charged by a railroad for setting a car on a shipper's track scales.

In Kentucky and Tennessee the wells and streams have become so low that the Cincinnati, New Orleans & Texas Pacific is compelled to carry water long distances in tank cars to supply its locomotives.

Senator Elkins, of West Virginia, Chairman of the Committee on Commerce, after conferring with the President, tells a reporter that he thinks there will be important legislation soon in regard to interstate commerce.

On the Boston Elevated Railroad (operating both elevated and surface lines) for the year ending September 30 the number of passengers carried was 241.7 millions, an increase of 3.4 per cent. over the preceding year. The average increase in the last ten years has been 5 per cent., and the present increase is the smallest per cent. since 1897.

Reports published in St. Paul say that 18 attempts have been made lately to wreck trains of the Canadian Pacific and the Canadian Northern in the region of Winnipeg and Lake Superior. Threatening letters have been received by officers of the roads, and it is supposed that the attempts at wrecking are made by blackmailers.

Shippers of fruit from Southern California are complaining loudly at what they seem to consider an injustice in the abrogation by the railroads of the through rates on fruit to the Southern States east of the Mississippi River, except to points on the lines of the Illinois Central, the Mobile & Ohio, and the St. Louis & San Francisco. The real situation seems, however, to be simply that the other roads in the Southeast are dissatisfied with the prices, and do not think it worth while to transport the fruit except at higher rates.

On the afternoon of November 30 the main line of the New York Central between Mott Haven and Spuyten Duyvil (New York City) was blocked for two hours by an open drawbridge and about 40 trains were delayed, including several of high degree, such as the Lake Shore Limited. The barge "Three Sisters," which got stuck in the mud while passing through the draw, was loaded with a thousand of brick, more or less. At the Grand Central Station the station master called in extra policemen to help keep the crowds in order.

The number of trains running to and from Broad Street Station, Philadelphia, now is 522 each week day, 258 in and 264 out. In the morning between 7 and 10 o'clock 62 trains arrive and 36 leave. In the afternoon between 4 and 7 o'clock 65 trains depart and 46 arrive. This is the largest winter schedule the Pennsylvania has ever had. A number of the trains are run in two and three sections. A large part of the trains have to be backed in empty previous to their departure, and backed out empty after their arival, making the number of movements to and from West Philadelphia much larger than that above mentioned.

On the morning of December 5 the Wells-Fargo express car on a train of the Atchison, Topeka & Santa Fe was robbed between the Needles and Daggett, Cal., and the messenger was fatally wounded. The robber escaped without being seen by any person except the messenger. While the train was in motion Messenger E. O. Roberts, hearing a noise on the platform, opened the door, and was at once attacked by the robber, who shot him twice through the body. The robber emptied one of the safes and jumped off while the train was in motion, and the crime was not discovered by the trainmen until the train reached Daggett.

From a press despatch dated Chicago, December 1, it would appear that the roads east of that city, with those west, have held a joint meeting and unanimously agreed not to cut rates or grant concessions of any kind to shippers. Whether there has really been a degree of irregularity making this action necessary, or the reporter has filled his space by reprinting an item from 1891, or some other ancient date, we are unable to guess. He wisely began his item with an "if": "If the agreement just entered into is firmly maintained there will be no more cutting of freight rates," etc.

The Pennsylvania Railroad has notified shippers and western connections that only perishable freight can be taken for points on the New York, New Haven & Hartford. Officers of the New Haven explain this embargo—which may last a week—by the statement that the manufacturers of New England postponed until October and November purchases of large quantities of coal, lumber, iron, and other bulky articles, which ought to have been procured in the summer. The month of October, 1902, was the heaviest month, for freight traffic, known on the New Haven up to that time; October, 1903, was much larger, and October, 1904, showed a still further increase of 5,014 cars received at the New York harbor terminus. Train movements are now somewhat retarded by the large number of improvements going on. Until a number of drawbridges are replaced with new ones, the time of the fast passenger trains between New York and Boston is to be kept 10 minutes slower than heretofore.

Needed, a Holding Company.

James Carley has been arrested at Council Bluffs, Iowa, charged with stealing the rails and ties from several miles of railroad. As he could not show that he was incorporated under the laws of New Jersey, he was thrown into jail.—*Washington Post.*

Street Car Fares in New York.

The Court of Appeals of the State of New York, in the suits of Griffin, Scudder and O'Reilly, has decided that every street railroad company must for a single fare (5 cents) carry a passenger to any point on the line of any road owned, operated or leased by it. The opinion, by Justice Bartlett, says that Section 104 of the law applies to the case of a lease by one railroad of the lines of another, and that Section 78 refers to any corporation owning or operating any railroad or railroad route. The two sections must be read together. The result of the decision, in Manhattan, is expected to be that the New York City Railway will give free transfers to passengers at all points where any of its lines intersect or connect with each other, and particularly at points of intersection between the lines which it operates substantially as owner, and those of the Third Avenue Railroad, which it leases.

Signal Observance Tests on the Southern Pacific.

The *Record-Herald*, of Chicago, prints a statement purporting to come from the "Harriman lines," presumably the Southern Pacific, showing the results of several thousand tests made to show how well enginemen and other trainmen observed the train rules. The table, for five months, follows:

	Tests observed.	Failures.	Per cent. of efficiency.
June	574	20	96.6
July	749	26	96.6
August	881	16	98.2
September	991	8	99.2
October	993	5	99.5

The statement shows that five of the failures (meaning, presumably, those in October) were as follows: One running past torpedo, two failures to check caboose indicator changed, one running past red flag and one failure to respect the absence of signal light in station semaphore. It will be observed that here, as in the case of similar tests reported in the *Railroad Gazette* of April 1 last, most of the failures occurred under circumstances in which the engineman assumed, or plausibly could have assumed, that his act was not dangerous.

Mr. Tuttle and the Operators.

The management of the Boston & Maine is to be congratulated on the good sense, courtesy and fairness of its negotiations just concluded with the railroad telegraphers, whereby the latter are granted a substantial increase of wages. This attitude if more generally adopted would take three-fourths of the bitterness out of present industrial relations, and draw the fangs of very many of the union practices justly complained of as abusive and oppressive. President Tuttle has publicly stated that it is his custom, when disagreements arise over wages or hours, to call in the union officials and exhibit and explain details in the financial results of the company's operations which are not ordinarily shown in the regular published reports; that never once has this confidence been betrayed, and never once has the practice failed to lead to an amicable settlement, whether the requests were granted or not. This is the kind of co-operation likely to prove much more satisfactory to the average intelligent workman than any of the more formal and spectacular schemes of dividing shares of stock in petty allotments among the employees, with the intent of creating a feeling of common interest, but too often also designed, there is reason to fear, as a means of tying the workman to his job and heading off demands for higher wages. When the question is propounded whether a policy like the Boston & Maine's would "work" or not, one at once thinks of Dr. Bartol's reply to the question: "Is not Christianity a failure?" "A failure? Why, it has never been tried!"—*Boston Transcript.*

Railroad Motor Car Services in England.

It is rather remarkable, at a time when nearly every British railroad manager is either experimenting with motor car services or awaiting eagerly the results of experiments by others, that there should be so little useful literature on the subject. The cost element, on which the whole question must ultimately hang, has not yet been reduced to the point where much definite, scientific information is available, and it frequently happens that the published operation cost of one car, or one service, will differ materially from those of another which is apparently worked under similar conditions. One difficulty in calculating working expenses arises from the fact that the short period during which rail motor cars of approved type have been in service gives but little indication of what the charge should be for depreciation. Where a steam motor is used, similar in general design to a small locomotive, an analogous estimate can be made for the upkeep of the engine, but petrol motors, and cars in which a petrol engine drives a dynamo, are still in the experimental stage. This is illustrated by the experience of a certain British railroad which recently tested through a considerable period of time two petrol road cars, similar in size and engine, and employed in similar services. At the close of the period it was found that repairs and maintenance of one car had cost nearly double the sum charged against the other, with no obvious reason for the difference. Certain facts are, however, definitely known. Disregarding fuel cost, repairs and maintenance, it is evident that the wages account of an electric motor car with a petrol-driven dynamo will be less than the wages account of a steam motor car, since the latter requires engineer, fireman and conductor—the same crew as that of a local train—while the petrol-electric car is able to dispense with the fireman, thereby reducing the train crew to two men. This saving is of such importance that it makes the development of petrol-electric cars a matter of great interest. The cost of working one of these cars, which has been in use some months on a British line, has been found to be approximately 7 cents per mile run for the items of fuel and wages, as against, say, 16 cents per mile for a light steam train.

But it must be noted that the function of a motor car is to provide a supplementary, rather than a primary, service. On a short branch line where four or five trains daily can take care of the business a rail-motor car is not likely to prove an economy, because it cannot well take the place of a locomotive in hauling freight cars. It may frequently happen on such a branch that the one locomotive needed for the freight traffic can handle the passenger traffic as well, with no additional charge except that for fuel; wages, interest and depreciation remaining the same as if it were used for freight business alone. It is evident that a motor car to handle the passenger traffic would be an extravagance here. But on branches where there is too much passenger business for one locomotive and not enough to keep two busy, a motor car which can be worked at half the cost of an extra train seems to be an excellent solution of the problem. The specific economies might be classified as follows:

(1) *Wage Saving.*—This applies primarily to petrol-electric cars. Steam motor cars require three men, the same as a branch-line train, but petrol-electric cars require only two.

(2) *Small Unit.*—A motor car can carry not to exceed about 50 passengers at much smaller fuel consumption than they can be carried for in a train. If more than 50 passengers are to be carried at one time, there is probably no economy in the use of motor cars, unless a trailer can be advantageously used.

(3) *Saving in Shunting.*—Much shunting is saved at terminals, because the cars drive from either end, and no turning or re-making the train is necessary.

(4) *Saving in Station Force.*—At intermediate stops or "haltes," no stations are required and no one need be in attendance. Tickets are sold on the car in such a case, or the fare is paid without the issuance of a ticket. In addition to these specific economies, there is also a saving in the labor needed to care for a motor car, as compared with an engine and train; in car service, in lubrication and in storage.

The general services which a railroad motor car is specially well adapted to perform may be divided roughly into two classes: services, as on branch lines, where the primary object is to save the working expense of an additional locomotive in handling traffic which already exists, and services intended to create new traffic at less cost than could be done in any other way. These two divisions at times overlap, but rail motor cars are so well adapted to originate certain types of local service, as for example in some cases where there is tram competition, that their function may differ from that of being an accessory to branch line working. One line had a sharp tram competition between two local points about four miles apart. Nine steam trains daily were formerly run between these points; now a rail-motor car is run every half-hour, and, at small cost, has greatly increased the railroad traffic. The steam motor cars on the Great Western are powerful enough to haul a number of trailing vehicles, and in some cases the new traffic built up has outgrown the capacity of a single car, and trailers are to be employed, with a controlling arrangement which will enable the train to be driven from either end.

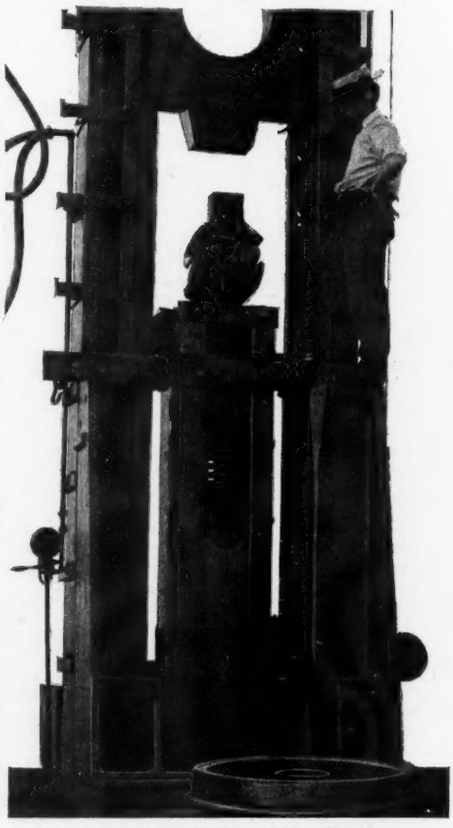
A desirable special service for which rail-motor cars are well adapted, and which belongs partly in the category of developing new business and partly in that of handling existing traffic with economy, is the collection of passengers from local main line points ahead of a through train, or the distribution of passengers after the train has passed. A motor car under these conditions could well perform a function similar to that which is performed, on a smaller scale, by hackney carriages in a city, and the territory reached at each of the stops made by the through train could be greatly extended, at small cost, and in a very convenient manner. Besides the saving in fuel and in car service, the special advantage of the motor car would be the ease with which it could be switched out of the way, and the simplicity of reversing its running direction at any point on the line where there was a cross over track. For all work of this sort a rail-motor car is similar to a tram, with the important advantage that it is running on private right of way, and is not restricted by the Board of Trade tramway speed limitations. A motor car which should run 30 miles an hour just ahead of the through train's schedule, picking up passengers 10 or 20 miles away from the stopping place, would save the traveller's time to a very important degree, and introduce to residents of small points along the line an element of convenience and of rapid transit which always tends to develop traffic.

On one English line where it was necessary to meet trolley competition, rail-motor cars were tried on a short, unprofitable branch, and have reduced the working loss by half, although a profit is not yet shown. The coal consumption of the cars (steam) on this branch is from one-fifth to one-sixth of the former locomotive coal consumption, but the train crew is the same.

The experiments made thus far show good economy and a large field of usefulness. What is lacking at present is the service test, which can alone determine the allowance that must be made for repairs and renewals, through a period of years. In the meantime, all definite information with regard to comparative operating results from motors of different types will be of great value, especially in determining the usefulness of motor cars in services which are, so to speak, on the border line between the apparent field of the motor car and the recognized field of the locomotive and train.

A Test of the Farlow Draft Gear.

The Farlow draft gear, which was described in the *Railroad Gazette* Nov. 6, 1903, was tested on the M. C. B. drop testing-machine at Purdue University, Sept. 12, 1904. The gear tested was of the single spring type and the official figures of the test as given by Prof. Goss show the following interesting facts.



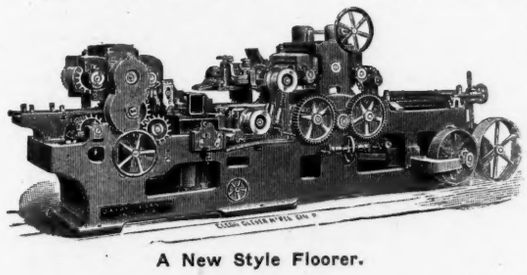
The Farlow Draft Gear After Testing.

The first six blows were at 5 ft., 7 ft., 10 ft., 15 ft., 20 ft. and 25 ft., respectively. Then followed seven blows at 34 ft., the full height of the machine. The second blow, which was at 7 ft., brought the horn of the coupler in contact with the sill, and blows from 10 ft. and 15 ft. were withstood without any apparent effect. A slight bending of the angle plate occurred after a blow at 20 ft., and a 25 ft. blow resulted in a slight bending of the links. After the above test seven blows at 34 ft. each were delivered to the gear. An examination of the gear was made after each blow. This treatment resulted in a gradual increase in the distortion of the metal parts and a yielding of the timber work supporting them, but the gear was still good for service, as can be seen in the accompanying illustration, which shows the gear as it appeared at the conclusion of the test. The wooden draft arms when exam-

ined by Prof. Goss after the test were found undamaged, and the test gear was taken apart in 8 min. by men who were not accustomed to the work and who did not know that they were being timed. Professor Hatt made an effort to determine the pressure equivalent of a blow of the 1,640-lb. tup, falling from a height of 34 ft. Two copper plugs 2 in. in diameter and 18 in. high were placed on the squared end of the upper coupler. The blow of the hammer compressed these blocks 0.282 in. each. A similar block was placed in the static Riehle testing machine of the laboratory, and it was found that a load of 176,000 lbs. was required to produce a similar effect of compression. If these two tests may be directly compared on the basis of equal compression of copper, the force due to the blow of the drop testing machine on the Farlow draft gear is twice 176,000, or 352,000 lbs. It is not claimed that this method is in the slightest degree scientific, but it may be accepted as an approximate measure.

A New Style Floorer.

The special advantages claimed for the floorer shown in the accompanying engraving are efficiency, economy of time, a minimum of labor and attention in making the various adjustments and superiority of product. It is especially efficient in the production of flooring, ceiling, casing, siding and work of that character, and the rapidity of its output is claimed to be limited only by the efficiency of its operators. It will work the four sides of material 15 in. wide and 6 in. thick, matching as narrow as 1½ in. All working parts of the machine are interchangeable and are compactly and strongly built, making a powerful and substantial structure. Twisted or warped lumber is readily worked by this floorer. The machine is also made with the lower cylinder cutting first, being then called No. 107, or with a third cylinder placed below the upper and called No. 108. In this last type the upper cylinder is placed between the two lower ones and the stock is worked face down, and is given an extra fine finish at a very high speed. Such an arrangement is intended particularly for makers of hardwood flooring. The builders are J. A. Fay & Egan Co., Cincinnati, Ohio.



A New Style Floorer.

A New Machine Tool Lubricant.

A new machine tool lubricant, known as "Lubria," has recently been introduced in this country, and many advantages are claimed for it. It is a thick, dark-colored mineral oil, found in limited quantities in Europe, and the peculiar feature of it is that it has the high specific gravity of .95. Because of this it has the property of forming an almost perfect emulsion with water in any proportion of mixture. Commercially it is sold in bulk in the pure state, and the consumer can add water in any quantity to give the required mixture. In practice it is generally used in the proportion of one part of Lubria to from 20 to 25 parts of water. No boiling or other process is required in mixing, and the emulsion is a stable one, which is shown by the fact that a sample which was allowed to stand for two months showed no appreciable separation of the oil and water. This new lubricant in the form of a diluted mixture gives particularly good results on such work as is turned out by turret lathes and automatic screw machines, where the tool is kept flooded by a constant stream of liquid. It is claimed that work done with it is as smooth and perfect as work flooded with pure oil and is much smoother than work done with soda water or soap solution. On account of the large proportion of water in the mixture the heat generated is carried away from the tool faster than where pure oil is used, and the work is therefore kept cooler and the tool kept in better condition. The lubricant is clean and runs freely, and as a consequence the pieces dropped down into the pan drain quickly, and when removed are much cleaner than work done with pure oil lubricants. The mixture can be used over and over again, until it becomes too dirty to run freely. For machining brass, copper, aluminum and similar metals and alloys it is said to give excellent results. Foote, Pierson & Company, 80 Fulton street, New York, are the selling agents in the United States.

Department of Agriculture Crop Estimate for 1904.

The preliminary returns to the Bureau of Statistics of the Department of Agriculture at Washington, published on Saturday last, indicate a total production of cotton in the United States in the year 1904-5, of 12,162,700 bales. Round bales have been included in this estimate and reduced to their equivalent in square bales. The estimate does not include linters. It is figured that including the linters this indicates a crop of 12,362,000 bales, or nearly one million more bales than in the record crop of 1899. Last year the Department of Agriculture estimate at this time was 9,962,039 bales, and the final crop amounted to 10,123,686 bales. The estimate of 12,162,700 bales is somewhat larger than had been generally expected. The report of the Census Office as to the amount of cotton ginned up to December 13 will throw additional light upon the estimate made by the Bureau of Statistics, and will probably indicate conclusively whether the estimate is too large or too small. The bales by States are as follows: Virginia, 19,300; North Carolina, 609,000; South Carolina, 1,099,700; Georgia, 1,764,900; Florida, 77,200; Alabama, 1,278,900; Mississippi, 1,539,800; Louisiana, 917,900; Texas, 2,992,300; Arkansas, 832,700; Tennessee, 343,000; Missouri, 43,900; Oklahoma, 246,000; Indian Territory, 398,100.

Progress in Western Canada.

The recent announcement that bonds of the Grand Trunk Pacific were for sale by Speyer Bros., London, and Speyer & Company, New York, calls attention to the fact that the railroad situation in Canada is in a state of rapid development. Not only is work to be begun in the early part of the spring on the Trans-Continental line of the Grand Trunk both east and west of Winnipeg, but the Canadian Pacific and the Canadian Northern are to make extensive improvements throughout the western part of Canada. A correspondent of the New York *Evening Post* says: The railroads are relying for their traffic in these new extensions on a great increase in immigration into Canada next year. The people of Western Canada anticipate a large influx of new settlers. There are at present twelve thousand tons of barbed wire in the warehouses at Fort William, all consigned to wholesale firms in Winnipeg, and all destined to be used on the prairies of Western Canada. This wire fencing is sufficient to fence a quarter of a million quarter sections of prairie land. A few years ago Winnipeg was a comparatively unimportant town, staggering under the after-effects of an exploded boom. To-day it counts a population of nearly 80,000 people. Edmonton is growing at a rapid rate, partly by reason of its position in an excellent country both for farming and small ranching, where Western American settlers are coming in in large numbers, and partly because both the Grand Trunk Pacific and the Canadian Northern will make Edmonton the chief center in the far western country. Brandon, Regina, Calgary, Prince Albert, and many other towns which lately were only names, are each becoming the distributing point for an important farming or ranching district. There are some exceptions; for instance, Battleford possesses the unique distinction of being the only town in the west which is as yet absolutely without railroad communication. To reach Battleford at present one must either drive by stage 100 miles over the trail from Saskatoon, or take the little steamboat which plies, at irregular intervals, up the North Saskatchewan from Prince Albert to Battleford. Undoubtedly this new prosperity is due in large part to the world's increased demand for wheat, its search for new wheat-growing lands, and its high bid for their product. This present year, the total wheat acreage in Manitoba and the Territories was something over 3,300,000. A conservative estimate gives 4,000,000 acres for 1905. This estimate is based upon authoritative reports from officials of the Dominion and Manitoba Governments, agents of the western Canadian railroads, and Winnipeg grain dealers.

Various adverse conditions brought the average yield per acre in western Canada this year down to 17 bushels. This is seven or eight bushels below the usual western Canadian average. At 25 bushels to the acre, with an available acreage of 4,000,000 acres, western Canada would have a crop in the fall of 1905 of 100,000,000 bushels; and at 20 bushels the crop would be 80,000,000 bushels, which far exceeds Canada's record crop of 1902.

The World's Wheat in 1903 and 1904.

The Bulletin des Halles, the most reliable French agricultural paper, makes the following estimate of the world's production of wheat in 1904:

Wheat Production of the World, 1903-1904.

Grand division.	Bushels 1903.	Bushels 1904.
Europe	1,697,108,750	1,496,213,750
America	847,561,250	766,125,000
Asia	380,793,500	436,975,000
Africa	53,061,250	55,898,750
Oceanica	82,287,500	61,006,250

A comparison with previous figures shows that the crop of 1904 in Europe was 200,895,000 bushels less than in 1903; that the crop of America was 81,436,250 bushels less than in 1903, and that the crop of Oceania was 21,281,250 bushels less than in 1903. The crops of Asia and Africa, on the other hand, have increased by 56,182,500 and 2,837,500 bushels, respectively. The crop in France shows a shortage of 62,425,000 bushels.—*Consular Report.*

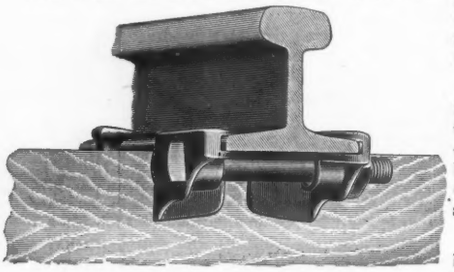
New Limited Electric Service.

On November 28, a service of limited cars was inaugurated on the Detroit, Ypsilanti, Ann Arbor & Jackson electric road between Detroit and Jackson. The distance is 76 miles and the schedule running time is three hours. The line runs on the highway. If the service proves popular, it is proposed to run the limited cars every two hours, with an extra charge of from 5 to 20 cents, according to distance. This will make the

third long distance limited service to be established from Detroit. The Detroit United lines have for some time maintained a service of limited cars to Port Huron, 74 miles, which had a schedule running time at last report of 2 hours and 37 minutes, and to Flint, 68 miles, run in 2½ hours. All three of these services are run on the highway for nearly the entire distance, at a speed but little slower than that of the railroad accommodation trains.

The Racine Rail Anchor.

This device consists of two malleable iron castings in the form of jaws which engage the flange of the rail. The jaws extend below the rail and brace against the tie, and



The Racine Rail Anchor.

are held together by a single bolt. The jaws have corrugations which cut into the rail when the bolt is tightened. Anchors on opposite rails may be connected by one long bolt to obviate spreading of the rails. Only one size of jaw is required, the bolt length being the variable in applying the device to different sizes of rails.

The anchor, which is a new device, is in use on several roads, and is claimed to be giving entire satisfaction. One of the large Chicago roads has a crossing about 60 miles north of that city, on which the anchors have been in use for about a year. Previous to their application the movements of the north and southbound tracks were respectively 2½ in. in 90 days, requiring the crossing to be taken up and readjusted at the end of that time. The expense each time was about $95. The cost of application of the Racine anchors was less than $6 a crossing, and since they have been in use no movement has been detected, it is said. It requires 12 to 20 sets of the anchors, that is, 6 to 10 on each rail, to hold the track from creeping at crossings, approaches to bridges, switches, etc.

A number of roads have the anchors on trial and the Chicago & North Western has just ordered 6,000 seats. They are sold by the Holland Company, Chicago.

Manufacturing and Business.

The Michigan Malleable Iron Co. announces the death of Mr. John L. Simpson, for many years purchasing agent of that company.

The Liggett Spring & Axle Co., of Pittsburg, Pa., it is reported, will spend about $60,000 in additions to its works at Axleton, opposite Monongahela.

The Reeves Foundry Co., of Trenton, has been incorporated in New Jersey with a capital of $60,000 by Clifton Reeves, Charles M. Heath and W. A. Holcomb.

The new machine shop for the Pere Marquette at St. Thomas, Ont., was completed November 28 at a cost of $50,000. About $50,000 will be spent for equipment.

The Harrods Motor Car Co. has been incorporated with a capital of $30,000 in New York by Edward J. Steiner and Edward Brand, of New York, and Harry Unwin, of Detroit.

The Globe Foundry Co., of Port Chester, has been incorporated in New York with a capital of $40,000 to make iron and steel, by John F. Mills, H. L. Marshall and Thomas Fitzgerald, all of Port Chester.

A. Leschen & Sons Rope Company, St. Louis, Mo., received three grand prizes at the World's Fair. One was for wire rope, another for wire rope tramways, and the third for conveying and transmission haulage outfits.

H. B. Underwood & Co., of Philadelphia, Pa., makers of special tools for railroad repair shops, it is reported, will build an addition to their works, increasing the floor space about 4,000 sq. ft., and will soon be in the market for machinery.

The Westinghouse Electric & Manufacturing Company, through their Mexican agents, G. & O. Braniff & Company, has obtained the contract for all the electrical apparatus to be installed at the El Oro Mining & Railway Company, El Oro, Mexico. This contract amounts to nearly $100,000.

Ground has been broken at Berwick, Pa., by the American Car & Foundry Co. for a 57 ft. x 72 ft. addition to the wheel foundry, to be used for the moulding of mine car wheels, increasing the output 40 wheels per day. A shed, 75 ft. x 200 ft., for the dismantling of cars for export shipment, is also being put up.

Reports from Sharon, Pa., state that the W. P. Snyder Co., of Pittsburg, will spend $2,000,000 in building a Bessemer steel plant at Sharpsville. W. P. Snyder was at the head of the Clairton Steel Co. before it was absorbed by the United States Steel Corporation. The company recently bought the Mabel furnace.

Mr. John G. Sanborn, formerly with the Chicago Pneumatic Tool Co., and more recently with the Chicago Storage Battery Co., has accepted a position with S. F. Bowser & Co., Fort Wayne, Ind., as railway representative for their oil house equipment and oil storage systems. Mr. Sanborn will make his headquarters in Chicago.

The Illinois Steel Co., it is reported, will add a beam mill with a monthly capacity of 12,000 to 15,000 tons of finished structural shapes to its works at South Chicago at a cost of about $1,200,000. One of the plate mills was to have been opened this week and a second one on the 14th inst., giving employment to about 1,000 men.

The Booth Water Softening Company, recently incorporated in New York, proposes to manufacture and install water softening plants for railroads and factories, industrial plants, etc. Those particularly interested are H. H. Sutro, A. C. Christensen, and L. M. Booth, all of whom have been until recently connected with the Industrial Water Company, which concern is engaged in the same line of work.

The Chicago Pneumatic Tool Co., Chicago, Ill., announces that the number of orders received this year for pneumatic tools is far in excess of the orders received up to the corresponding time last year. An order for 705 tools has been received from its London branch, the Consolidated Pneumatic Tool Co. The electric drill which the company is making has proved a success, and it is expected that the sale of electric drills, in time, will exceed that of the pneumatic drills.

S. F. Alden & Co., Rialto Building, San Francisco, Cal., completed their first year of business on December 1. The concern acts as manufacturers' agent for machinery, railroad equipment and supplies, and appliances for gas and electric light plants, such as gas holders, poles, lumber, etc. The first year's business is reported to have been a most satisfactory one. Mr. Alden was for many years engaged in the construction, rebuilding and operation of gas, electric light and railway properties in different parts of the country, and was also purchasing agent for several such companies.

Iron and Steel.

The Buffalo & Susquehanna has given an order to the Lackawanna Steel Co., of Scranton, for 1,500 tons of rails.

The Republic Iron & Steel Co. expects to have its new rail mill at Youngstown, Ohio, in operation about the first of next May. This mill will have a capacity of about 250,000 tons of rails yearly.

The Pennsylvania Steel Co. reports that business is rapidly improving. There is a good demand for structural steel and bridge material all over the country and the mills are running on full time.

The exports of iron and steel for the month of October were $12,798,481, as compared with $8,982,426 in October, 1903; and 69,380 tons of rails worth $1,906,828, as compared with 6,379 tons worth $183,096 in October, 1903.

Large orders for track and shop equipment for the Gould lines, it is reported, have been placed; also for bridge material as follows: By the Louisville & Nashville for 2,500 tons, the Buffalo & Susquehanna for 1,500 tons, and the Lake Shore & Michigan Southern about 200 tons.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies see advertising page 24.)

Engineering Association of the South.

The sixteenth annual meeting of this association will be held at Nashville, Tenn., December 17.

New York Railroad Club.

The next regular meeting of this club will be held at Carnegie Hall, 57th Street, Manhattan, December 16, at which a paper on "Theory and Practice of Single Track Blocking" will be read by H. D. Emerson.

Franklin Institute.

At a stated meeting of the Sections in Philadelphia, December 2, the program included papers on "Electrical Waves and the Behavior of Long Distance Transmission Lines," by Professor W. S. Franklin, Lehigh University, and "An Ampere Meter for High-Potential Currents, by H. Clyde Snook, Roentgen Manufacturing Co., Philadelphia.

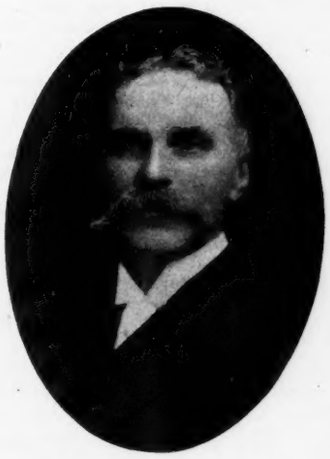
M. M. and M. C. B. Conventions.

The thirty-eighth annual convention of the American Railway Master Mechanics' Association and the thirty-ninth annual convention of the Master Car Builders' Association will be held at Manhattan Beach, N. Y., June 14 to 21, 1905, inclusive. The Oriental Hotel will be headquarters and the meetings of the Associations will be held in the ball room at that place. There are two hotels at Manhattan Beach, the Oriental and the Manhattan Beach, about 1,400 ft. apart, and one at Brighton Beach, the Hotel Brighton, about one-quarter of a mile beyond the Manhattan Beach Hotel. All three are connected by an electric railroad which will carry members and guests to the convention without charge. The Oriental Hotel will be given

over entirely to the convention. The rates at the three hotels are as follows: Single room, one person, without bath, $3.50 a day; double room, one person, without bath, $4.50 a day; double room, two persons, without bath, $3.75 a day each; extra large double room, two persons, without bath, $4.75 a day each; single room, one person, with bath, $5.00 a day; double room, one person, with bath, $6.00 a day; double room, two persons, with bath, $5.00 a day each; extra large double room, two persons, with bath, $6.00 a day each. Rooms may be reserved from now on at the Oriental and Manhattan Beach hotels by addressing the Manhattan Beach Hotel & Land Co., 192 Broadway, New York City; or at the Hotel Brighton, through Mr. Geo. B. Parker, Grand Hotel, New York City. The exhibits will be placed on the grounds back of the Oriental Hotel and on the veranda of that structure. Those wanting space must apply to J. Alexander Brown, Secretary, Supplymen's Association, 24 Park Place, New York City.

PERSONAL.

—Mr. Frederick Alexander Wann, who has been chosen to succeed the late Mr. Parker as First Vice-President of the Pere Marquette and Second Vice-President of the Cincinnati,



Hamilton & Dayton, in charge of the traffic interests of both roads, was born in Ireland 54 years ago. Mr. Wann's railroad career began in 1869. Starting as a clerk in the general superintendent's office of the Kansas Pacific he was later appointed to a clerical position in the general freight office of the Leavenworth, Lawrence & Galvestop, and two years later was made chief clerk of the same department on the Missouri, Kansas & Texas. In 1876 he became general eastern agent of the M., K. & T. in New York, and in 1879 was promoted to be Assistant General Freight Agent at Sedalia, Mo. In 1881 he took a simiiar position on the Chicago & Alton, which position he held for 15 years. In 1896 he was promoted to the position he now resigns, that of General Freight Agent.

—Mr. Frederick McNaughton, who was for 30 years Roadmaster on the Great Northern, the Chicago Great Western and the Chicago, St. Paul, Minneapolis & Omaha, died recently at Grand Rapids, Minn., at the age of 62.

—Mr. Buren M. Wasson, publisher of *Roadmaster and Foreman*, Chicago, died in that city on Sunday, the 4th inst. Mr. Wasson was also engaged in the railroad supply business, the firm name being B. S. Wasson & Company. He was 45 years old.

—Mr. E. E. Davis, Superintendent of Motive Power of the Buffalo, Rochester & Pittsburg, is a native of New Hampshire. Mr. Davis's railroad service began on the Boston & Maine, where he reached the position of Master Mechanic, which office he held for about six years. He resigned from railroad work to go to Scranton, Pa., where for three years he was Superintendent of the Boies

Steel Wheel Company. Leaving that company, he again entered railroad service as Assistant Superintendent of Motive Power of the Philadelphia & Reading, and remained with that company for five years. From this road he went to the New York Central & Hudson River as Assistant Superintendent of Motive Power. Four years later he again left railroading to take the Superintendency of the Ramapo Iron Works at Hillburn, N. Y., which position he now resigns to go to DuBois, Pa., to succeed Mr. Hyndman as Superintendent of Motive Power.

—Mr. Manley B. Cutter, who in the early part of last year became General Superintendent of the Lehigh Valley, is now promoted to be General Manager. This latter position has been vacant since the resignation of Colonel Wilbur, about three months ago. Mr. Cutter is about 44 years old, and began railroad work at the age of 16. He began as a messenger for the Chicago & North Western, but in a few years left

that company to go to the Northern Pacific, where he remained six years. In 1887 he went to the Chesapeake & Ohio, and for a time was Division Superintendent. He afterward held a similar position on the Wisconsin Central. In 1891 he resigned and went to the Chesapeake, Ohio & Southwestern and the Louisville, New Orleans & Texas as General Superintendent, and held that position until these roads were consolidated with the Illinois Central. Mr. Cutter spent about four years as Division Superintendent of the Baltimore & Ohio and has been in the service of the Lehigh Valley since 1897, where until February, 1903, he was Superintendent of Transportation. As General Superintendent, Mr. Cutter had charge of Maintenance of Way, Maintenance of Equipment, conducting transportation, Lake Marine and Canal lines. Mr. Cutter has created a good record for activity, energy and progressive operating methods.

—Mr. Wallace C. Winter will in the latter part of this month leave the service of the Chicago, St. Paul, Minneapolis & Omaha to go to Chicago to become a member of the firm of Pettibone, Mulliken & Company, dealers in railroad supplies. It is not quite a year since Mr. Winter was promoted to be General Superintendent of the Omaha. His whole railroad career has been with that company. A portrait and sketch of Mr. Winter's life was published at the time of his promotion to the General Superintendency. (March 20, 1903, p. 219.)

—Mr. Joseph H. Young, the new General Superintendent of the Colorado & Southern, was for some time at the head of the operating department of the Rio Grande Western in Salt Lake City. Mr. Young was born in

that city 40 years ago and was educated at the University of Utah. His first railroad work was in the engineering department of the Union Pacific. Then for a time he was an operator at various points on the Utah Central, but shortly returned to the Union Pacific. Later he worked on the Chicago & North Western, and the Salt Lake & Eastern. In 1889 Mr. Young was appointed Superintendent of the Utah Central, and two years later was appointed Superintendent of the Utah Division of the Union Pacific. In 1902 he went to the Rio Grande Western as General Superintendent, which position he now resigns to go to Denver as General Superintendent of the Colorado & Southern.

—Mr. E. P. Goodwin, whose promotion to the Superintendency of the Cincinnati Division of the Chesapeake & Ohio at Covington, Ky., was recently announced, has been in the service of that company for the past 28 years. He began at the age of 14 as a messenger, and was a telegraph operator and agent at various points until 1882, when he was made despatcher at Huntington, W. Va. In January, 1903, he was appointed Trainmaster. The next year he was promoted to be Assistant Superintendent of the Huntington Division at Hinton, W. Va., and the first of this month was transferred to the Cincinnati Division.

—General William Barclay Parsons, Chief Engineer of the Rapid Transit Commission, has resigned. Gen. Parsons is a member of the Isthmian Canal Commission, and it is understood that he intends in the early part of January to go to Panama. Gen. Parsons' work in connection with the New York subway is too well known to the readers of the *Railroad Gazette* to need repeating at this time. He has decided to go into private practice as a consulting engineer, and the Rapid Transit Company has asked him to act as consulting engineer for the company. Now that General Parsons has brought his highly important task to a most successful conclusion, it is easy to understand that he should desire to direct his future efforts towards the planning and accomplishment of new work in other fields. One feature of the building of the subway which is often overlooked is that, at a period when New York had most urgent need for rapid transit, and when an engineering problem of the first magnitude had to be met, involving much pioneer work, the task was finished within the estimated time. That this could have been accomplished in the face of all difficulties adds much glory to the record both of Gen. Parsons and of Mr. McDonald.

—Mr. T. A. Lawes, who has been appointed to succeed Mr. Carroll as Mechanical Engineer of the New York, Chicago & St. Louis at Cleveland, has for the past eight years been Superintendent of Motive Power of the Chicago & Eastern Illinois. Mr. Lawes has been in railroad service since 1866, when he began as a machinist on the Terre Haute & Richmond, which is now a part of the Vandalia Line, and until 1882 held the positions of machinist, draftsman and gang and general foreman. In the latter year he resigned and went to the "Big Four" as draftsman and was successively promoted until he became Master Mechanic. In 1891 Mr. Lawes left that company and went to the Erie as Engineer of Tests and was later made Master Mechanic. Then he was with the Fisher Electric Company, Detroit; later re-entered railroad service as Mechanical Engineer of the Big Four, which position he held until his appointment in 1896 to the position he now leaves, that of Superintendent of Motive Power of the Chicago & Eastern Illinois.

ELECTIONS AND APPOINTMENTS.

Canadian Pacific.—A. W. Horsey, hitherto Chief Draftsman, has been appointed Mechanical Engineer, with office at Montreal.

Hayter Reid has been appointed General Superintendent of hotels.

Chicago & Alton.—J. N. Faithorn, Vice-President, has resigned. F. A. Wann, General Freight Agent, has resigned. (See Pere Marquette.)

Chicago & Eastern Illinois.—T. A. Lawes, Superintendent of Motive Power, has resigned. (See New York, Chicago & St. Louis.)

Chicago, Burlington & Quincy.—E. W. Fitt, hitherto Chief Draftsman, has been appointed Assistant Superintendent of Motive Power, with headquarters at Lincoln, Neb.

J. A. Hayes has been appointed to his old position, Superintendent of Bridges and Buildings, at Creston, Iowa. Mr. Hayes had been in charge of some new construction work which is now finished.

Chicago, Cincinnati & Louisville.—See Pere Marquette.

Chicago Great Western.—Charles R. Berry, hitherto Assistant General Freight Agent of the Pere Marquette, has been appointed Assistant General Freight Agent of the C. G. W., with headquarters at St. Joseph, Mo.

Chicago, Rock Island & Pacific.—M. E. Sebree has been appointed Superintendent of the El Paso Division of the C., R. I. & P.; Superintendent of the Mexico Division of the Chicago, Rock Island & Gulf, and Superintendent of the Chicago, Rock Island & El Paso, with headquarters at Dalhart, Texas, succeeding R. R. Sutherland, resigned, effective Dec. 15.

Chicago, St. Paul, Minneapolis & Omaha.—Wallace C. Winter, General Superintendent, has resigned.

Cincinnati, Hamilton & Dayton.—F. H. Short, Treasurer, has resigned. (See Pere Marquette.)

Denver & Rio Grande.—F. Mertsheimer, Superintendent of Motive Power and Car Department, has resigned.

Empire Line.—L. M. Souders has been appointed Western Superintendent, with office at Cleveland, Ohio, succeeding L. G. Kies, deceased.

Grand Trunk.—J. Markey has been appointed Master Mechanic of the Northern Division, with headquarters at Allandale, Ont., succeeding N. B. Whitsel, resigned.

W. H. Biggar, K. C., has been appointed General Solicitor at Montreal, in place of John Bell, K. C., who retires after more than 50 years service. Mr. Bell will continue in the service of the company as Consulting General Counsel.

Hannibal & St. Joseph.—P. H. Houlahan, Superintendent at Brookfield, Mo., has resigned. (See Toledo, St. Louis & Western.)

Lake Erie & Western.—F. J. Pease, hitherto General Foreman of Shops on the Michigan Central at Michigan City, has been appointed General Foreman of Shops on the L. E. & W. at Lima, Ohio.

Lehigh Valley.—T. H. Pindell has been appointed Superintendent of Transportation, with headquarters at South Bethlehem, Pa., reporting to the General Manager. He will maintain supervision over the movement of car equipment, and train service, and give instructions to the Superintendents in relation to time-tables, classification of trains, distribution and movement of cars, and all other matters connected with that service. He will have charge of the distribution of all car equipment; also perform such other duties as may be assigned to him by the General Manager, and will, in his absence, act for him. R. W. Baxter has been appointed Superintendent of the Wyoming Division, succeeding Mr. Pindell, and C. W. Kinney will in turn succeed Mr. Baxter as Superintendent of the Pennsylvania Division. Thomas O. Cole has been appointed Car Accountant, with office at South Bethlehem. The position of Superintendent of Car Service has been abolished.

M. B. Cutter, hitherto General Superintendent, has been appointed General Manager, with headquarters at South Bethlehem, Pa., and 143 Liberty street, New York City. The position of General Superintendent has been abolished.

Morgantown & Kirkwood.—C. F. Sutherland has been appointed General Freight Agent.

Mobile & Ohio.—C. F. Blue, hitherto Roadmaster, has been appointed Superintendent of Way and Structure.

New York Central & Hudson River.—Charles H. Quereau, hitherto Superintendent of Shops at West Albany, has been appointed Engineer of Tests, with headquarters at Albany, N. Y.

New York, Chicago & St. Louis.—T. A. Lawes, hitherto Superintendent of Motive Power of the Chicago & Eastern Illinois, has been appointed Mechanical Engineer of the N. Y., C. & St. L., with headquarters at Cleveland, Ohio, succeeding J. T. Carroll, resigned.

New York, New Haven & Hartford.—W. R. Maure, hitherto in the mechanical department of the Buffalo, Rochester & Pittsburg, has been appointed Mechanical Engineer of the N. Y., N. H. & H., with headquarters at New Haven, Conn.

Northern Pacific.—R. M. Crosby, hitherto Master Mechanic of the Chicago Great Western, has been appointed Superintendent of the South Tacoma shops of the N. P. J. E. O'Brien, hitherto Master Mechanic of the Dakota Division at Jamestown, N. Dak., has been appointed Assistant Superintendent of the South Tacoma shops. R. P. Blake, hitherto Mechanical Engineer at St. Paul, has been appointed Assistant Superintendent of the Brainerd shops.

Pere Marquette.—Frederick A. Wann, hitherto General Freight Agent of the Chicago & Alton, has been appointed First Vice-President of the P. M., and Second Vice-President of the Cincinnati, Hamilton & Dayton, succeeding the late C. A. Parker.

The jurisdiction of A. L. Sanger, Purchasing Agent, has been extended over the Cincinnati, Hamilton & Dayton and the Chicago, Cincinnati & Louisville. Mr. Sanger's office will be in Cincinnati. J. W. Harris has been appointed Assistant Engineer of the Buffalo Division of the P. M., with office at St. Thomas, Ont., succeeding Owen McKay, resigned.

Rio Grande Western.—A. E. Welby has been appointed General Superintendent, succeeding J. H. Young, resigned.

St. Louis & San Francisco.—D. G. Reid has been elected Chairman of the Board of Directors.

W. B. Drake has been appointed Assistant to the Second Vice-President.

Southern Pacific.—H. H. Thrall, lately Division Superintendent of the United States Railway Post Office at San Francisco, has been appointed Superintendent of Mails for all the "Harriman" lines.

Tennessee Central.—The position of Mechanical Superintendent has been abolished.

Toledo, Peoria & Western.—G. W. Winters, hitherto Assistant General Passenger Agent, has been appointed General Passenger Agent, with headquarters at Peoria, Ill.

Toledo, St. Louis & Western.—P. H. Houlahan, hitherto Superintendent of the Hannibal & St. Joseph at Brookfield, Mo., has been appointed General Superintendent of the T., St. L. & W., with headquarters at Toledo, Ohio, succeeding R. Williams, resigned, effective about Dec. 15.

Vera Cruz & Pacific.—Gustavo Navarro has been appointed Superintendent of Motive Power and Machinery, with headquarters at Tierra Blanca. W. A. Hill, hitherto Superintendent of Maintenance of Way, has been appointed Chief Engineer, with headquarters at Orizaba. The offices of Superintendent of Rolling Stock and Materials, Engineer of Maintenance of Way and Construction, and Superintendent of Transportation, have been abolished.

Wabash.—J. E. Stumpf, hitherto Superintendent of Terminals at St. Louis, has been appointed Superintendent of the Springfield Division, with headquarters at Springfield, Ill. J. E. Taussig, hitherto Superintendent and Superintendent of Telegraph of the Wheeling & Lake Erie, has been appointed to succeed Mr. Stumpf on the Wabash, with office at St. Louis.

Wheeling & Lake Erie.—(See Wabash.)

LOCOMOTIVE BUILDING.

The Pennsylvania has ordered 15 locomotives from the Baldwin Locomotive Works.

The Pennsylvania has ordered 15 switching (0-6-0) locomotives from the American Locomotive Co.

The New Orleans Terminal Company is having three locomotives built at the Baldwin Locomotive Works.

The Buffalo & Susquehanna has ordered 12 heavy freight consolidation (2-8-0) locomotives from the American Locomotive Co.

The Queen & Crescent is reported to have ordered 17 locomotives. We understand that this order has been placed with the American Locomotive Co.

The Baldwin Locomotive Works will build a four-cylinder balanced compound Atlantic type (4-4-2) locomotive to be used in competitive tests against the four-cylinder balanced compound Cole locomotive built by the American Locomotive Co. and recently on exhibition at the St. Louis Exposition.

The Boston & Maine, as reported in our issues of November 25 and December 2, has ordered 10 simple switching (0-6-0) engines from the American Locomotive Co. These locomotives will weigh 114,000 lbs.; cylinders, 19 in. x 24 in.; diameter of drivers, 50 in.; straight radial stay boiler, with a working steam pressure of 160 lbs.; heating surface, 1,635.7 sq. ft.; 259 tubes 2 in. in diameter and 11 ft. long; fire-box, 102 in. long and 33 in. wide, inside measurement; grate area, 23.5 sq. ft.; tank capacity, 4,000 gallons of water, and coal capacity, seven tons. Special equipment includes: Westinghouse-American air-brakes, Carnegie steel axles, Franklin 85 per cent. magnesia boiler lagging; Sterlingworth brake-beams, American Brake-Shoe & Foundry Co.'s brake-shoes, Tower couplers, Dewey headlights, Hancock injectors, U. S. metallic piston rod and valve rod packings, Ashton safety valves, Leach sanding devices, Pittsburg Spring & Steel Co.'s springs, Midvale driving-wheel tires and Standard steel tired wheels.

The Delaware, Lackawanna & Western, as reported in our issue of November 25, has ordered eight simple consolidation (2-8-0) locomotives, 12 simple American (4-4-0) locomotives, and 12 simple switching (0-6-0) engines from the American Locomotive Co. The consolidation locomotives will weigh 191,500 lbs., with 171,700 lbs. on drivers; cylinders, 21 in. x 26 in.; diameter of drivers, 57 in.; wide fire-box, with a working steam pressure of 200 lbs.; heating surface, 2,773 sq. ft.; 350 National charcoal iron tubes 2 in. in diameter and 14 ft. long; fire-box, 126¼ in. long and 108¼ in. wide; grate area, 95 sq. ft.; tank capacity, 6,000 gallons of water, and coal capacity, 10 tons. The American type locomotives will weigh 140,000 lbs., with 93,000 lbs. on drivers; cylinders, 20 in. x 26 in.; diameter of drivers, 69 in.; straight-top boiler, with a working steam pressure of 185 lbs.; heating surface, 2,143 sq. ft.; 280 National charcoal iron tubes 2 in. in diameter and 13 ft. 4½ in. long; fire-box, 126 in. long and 100 in. wide; grate area, 87.6 sq. ft.; tank capacity, 5,000 gallons of water, and coal capacity, 10 tons. Six of the switching engines will have a wide fire-box for the use of anthracite, while the other six will be semi-wide fire-box for the use of soft coal. All these locomotives will weigh 132,000 lbs.; cylinders, 19 in. x 24 in.; diameter of drivers, 51 in.; straight-top boiler, with a working steam pressure of 180 lbs.; heating surface of the wide fire-box locomotives, 1,863 sq. ft.; heating surface of the soft-coal locomotives, 1,854 sq. ft.; 270 tubes 2 in. in diameter and 12 ft. long; fire-box of anthracite locomotives, 8 ft. 6 in. long and 8 ft. wide, with a grate area of 68 sq. ft.; fire-box of soft-coal locomotives, 7 ft. 6 in. long, 6 ft. 3 in. wide, with a grate area of 53.4 sq. ft.; tank capacity, 3,300 gallons of water, and coal capacity, six tons. Special equipment for all includes: Westinghouse-American brakes, Gollmar bell ringers, sectional magnesia boiler lagging, Sterlingworth brake-beams, Gould couplers, American Brake Shoe & Foundry Co.'s brake-shoes, Dressel headlights, Hancock injectors, Magnus Metal Co.'s journal bearings, U. S. metallic piston rod and valve rod packings, Consolidated safety valves, Leach sanding devices, Nathan sight-feed lubricators, D., L. & W. standard springs, Ashcroft steam gages, Midvale driving-wheel tires and cast-iron wheel centers. Other specialties include: Hancock pneumatic cylinder cocks on all locomotives, Sessions-Standard friction draft gear on switching engines, and Zero anti-friction metal on all bearings in place of babbitt.

CAR BUILDING.

The Lehigh Valley is in the market for 100 gondolas.

The Swift Refrigerator Transportation Co. is asking prices on 100 stock cars.

The Buffalo & Susquehanna has ordered 350 coal and 100 box cars from the Barney & Smith Car Co.

The Cumberland Valley has ordered 40 standard class X1 box cars from the American Car & Foundry Co.

S. Pearson & Son is having 50 freight cars built at the St. Charles Works of the American Car & Foundry Co.

The Rodger Ballast Car Company has ordered 125 Hart convertible ballast cars from the American Car & Foundry Co.

The Westmoreland Coal Company is having 27 freight cars built at the McKees Rocks Works of the Pressed Steel Car Co.

The St. Louis & San Francisco has ordered 100 furniture cars from the American Car & Foundry Co. in addition to the 300 reported in our issue of November 18.

The Minneapolis, St. Paul & Sault Ste. Marie has ordered 150 freight cars from the American Car & Foundry Co., instead of 200, as reported in our issue of November 25.

The Mississippi Central has ordered one 60-ft. baggage and mail car, one first class 52-ft. passenger coach and 100 flat cars of 80,000 lbs. capacity from the American Car & Foundry Co.

The Grand Trunk, as reported in our issue of November 25, has ordered 1,000 box cars from the Western Steel Car & Foundry Co. Special equipment includes: Miner draft rigging, Hutchins roofs, Westinghouse brakes, Climax couplers and Dunham door fixtures.

The Lake Shore & Michigan Southern, as reported in our issue of November 18, has ordered 1,000 drop-bottom gondolas of 100,000 lbs. capacity from the Pressed Steel Car Co. These cars will be 38 ft. long, 10 ft. 2½ in. wide and 4 ft. 2 in. high, with steel frames. The special equipment includes: Westinghouse brakes and Lake Shore & Michigan standard arch-bar trucks.

The Illinois Central, as reported in our issue of November 25, has ordered 500 refrigerator cars from the American Car & Foundry Co. The cars will weigh 34,000 lbs. and will measure 38 ft. 8 in. long, over end sills; 9 ft. wide over side sills, and 7 ft. 6⅛ in. high in the clear, inside measurement. Special equipment includes Common-Sense body bolsters, Simplex brake-beams, Hewitt Mfg. Co.'s brasses, Illinois Central standard insulated doors, Ryan dust-guards, Woodman journal boxes and lids, Sherwin-Williams Co.'s paint, Railway Steel-Spring Co.'s springs, arch-bar trucks and American Car & Foundry Co.'s wheels.

The Duluth & Iron Range, as reported in our issue of December 2, has ordered 300 hopper bottom ore cars of 100,000 lbs. capacity from the Standard Steel Car Co., for March, 1905, delivery. These cars will weigh about 31,000 lbs., and measure 24 ft. long. The special equipment includes: Simplex bolsters, Standard Steel Car Co.'s brake-beams, Streeter steel back brake shoes, Westinghouse air-brakes and draft rigging, Camel brasses, Chicago and Climax couplers, McCord and Symington dust guards, journal boxes and lids, Pittsburg Steel-Spring Co.'s springs, Barber-Woods trucks and New York Car Wheel Co.'s wheels.

The Duluth, Missabe & Northern, as reported in our issue of December 2, has ordered 800 steel hopper gondola cars of 100,000 lbs. capacity from the Standard Steel Car Co., for March, 1905, delivery. These cars will weigh 32,000 lbs., and measure 24 ft. long, 8 ft. 6 in. wide and 9 ft. high. The special equipment includes: Carnegie axles, Simplex bolsters, Standard Steel Car Co.'s brake-beams, Streeter steel back brake shoes, Westinghouse air-brakes, Camel brasses, Chicago and Climax couplers, Westinghouse friction draft rigging, McCord and Symington journal boxes and lids, Railway Steel-Spring Co.'s springs, arch-bar trucks, with Barber rollers, and New York Car Wheel Co.'s wheels.

The Delaware, Lackawanna & Western has ordered 1,000 box cars from the American Car & Foundry Co. and has placed orders for 300 refrigerator cars and 500 steel hopper coal cars. The box and refrigerator cars will weigh about 34,500 lbs. and will have a capacity of 60,000 lbs. The refrigerator cars will be 36 ft. long, 8 ft. 1¼ in. wide and 7 ft. 7¾ in. high, inside measurement, and the box cars will be 36 ft. long, 8 ft. 6 in. wide and 8 ft. high, inside measurement. The steel hopper coal cars will weigh about 35,000 lbs. and will have a capacity of 80,000 lbs. They will be 31 ft. 6 in. long over end sills, 10 ft. wide over all, and 9 ft. 10 in. high from rail to top of body, with metal frames and underframes. The special equipment for all includes: Simplex bolsters and brake-beams, Lappin brake shoes, Westinghouse automatic quick-action brakes, Magnus Metal Co.'s brasses, M. C. B. automatic 5 in. x 7 in. shank couplers, Miner tandem draft rigging, Symington and Woodman journal boxes, Sherwin-Williams Co.'s paint, Pittsburg Spring & Steel Co.'s springs, arch-bar trucks with Barber roller bearings, cast-iron wheels, Smith door fixtures on box cars and La Flare doors on refrigerator cars.

The Harriman Lines, as reported in our issue of December 2, have placed orders with the American Car & Foundry Co. for 750 box and 200 stock cars for the San Pedro, Los Angeles & Salt Lake, 300 box and 700 stock cars for the Southern Pacific, 300 box cars for the Oregon Railway & Navigation Co., and 300 stock cars for the Oregon Short Line. An order has also been placed with the Pressed Steel Car Co. for 750 drop-bottom gondolas. The box cars will weigh 44,000 lbs. and will be 40 ft. long, 8 ft. 6 in. wide and 8 ft. high, with metal underframes. The stock cars will have a capacity of 80,000 lbs. and will be 36 ft. 6 in. long, inside measurement; 8 ft. 5⅛ in. wide and 8 ft. high, with steel underframes. The drop-bottom gondolas will have a capacity of 100,000 lbs. and will be 40 ft. 4 in. long, 9 ft. 4⅞ in. wide, and 4 ft. 6 in. high, all inside measurement, with steel frames and underframes. Special equipment for all includes: Simplex bolsters, Damascus 6-in. I-beam brake-beams, American Brake Shoe & Foundry Co.'s brake-shoes, Hewitt Manufacturing Co.'s brasses, Climax couplers, Miner draft rigging, National Malleable Castings Co.'s journal boxes and journal box lids, Railway Steel-Spring Co.'s springs and arch-bar trucks.

BRIDGE BUILDING.

AKRON, OHIO.—The East Exchange street viaduct to abolish grade crossings, it is reported, is to be built at once. J. W. Payne is City Engineer.

ANACONDA, MONT.—The Northern Pacific, reports say, has plans ready for building a stone viaduct over Harrison avenue to carry five tracks.

BILLINGS, MONT.—Bids are wanted January 11 by J. W. Fish, County Clerk, for building a steel or combination highway

bridge over the Yellowstone river near Junction, Mont.

BUFFALO, N. Y.—The Committee of Wharves and Harbors has been asked to make a report on the question of removing the railroad bridges over the Buffalo river, the United States authorities having begun action to compel their removal.

CALABOGIE, ONT.—The County Councils of Bogot and Blythfield will erect a steel bridge.

CHICKASHA, IND. T.—The Rock Island engineers, local reports state, have completed the preparatory work for the new bridge over the South Canadian river near this place to replace the structure destroyed by floods last summer. The new bridge will be much larger and stronger than the old one.

COEUR D'ALENE, IDAHO.—The Northern Pacific, local reports state, is making surveys to locate a site for a bridge over the Spokane river to cost between $20,000 and $30,000.

DES MOINES, IOWA.—Plans are on file with W. W. Wise, a member of the Board of Public Works, for a new concrete and steel bridge, which call for three fixed spans of 120 ft. each to be built over the Des Moines river at Locust street at a cost of about $135,000.

FORT WILLIAM, ONT.—Residents of this place have petitioned the government for an appropriation to build a bridge over the Kaministiqua river.

GLACE BAY, N. S.—The Town Council has decided to build an overhead steel bridge over the railroad track on the proposed new road to New Aberdeen.

HAMILTON, ONT.—Bids will soon be asked by the Hamilton, Grimsby & Beamsville Railroad for building a bridge over its tracks.

HARRISBURG, PA.—Bids are wanted December 20 by John M. Shumaker, Superintendent of Public Grounds and Buildings, for rebuilding the substructure and the superstructure of the bridge over the west branch of the Lackawaxen river in the borough of Seelyville, Wayne County.

Bids are also wanted on the same date for rebuilding the bridge over Nescopec creek in Nescopec township, Luzerne County.

HOUMA, LA.—Bids are wanted the first week in January by H. M. Wallace, Mayor, for building a steel bridge over the Bayou Terrebonne.

KANSAS CITY, MO.—The Kansas City, Mexico & Orient will build a trestle over Walnut river 308 ft. long, one 308 ft. long over Duranchon creek, and one 224 ft. long over the second crossing of Walnut river on the line of its extension between Eldorado and Matfield Green in Butler and Chase Counties, Kansas.

LA CROSSE, WIS.—The City Council, it is reported, is asking bids for a bridge over Black river.

LONDESBOROUGH, ONT.—Bids are wanted by J. Campbell, Clerk of township of Hullett, for building two bridges with concrete abutments and steel superstructures.

LOUISA, KY.—Bids are now being asked by the Louisa & Fort Gay Bridge Co., organized to build a bridge from the foot of Madison street to a point directly opposite in Fort Gay, W. Va., over the Big Sandy river, at an estimated cost of about $35,000. J. R. Northup is President.

NASHVILLE, TENN.—The committee appointed to report on a new bridge over the Cumberland river recommends that steps be taken to secure the necessary legislation for permission to build. Captain A. J. Harris is Chairman.

NEW YORK, N. Y.—On the report of the Finance Committee, the Board of Aldermen has authorized Bridge Commissioner Best to make changes in the accepted plans of the Blackwell's Island bridge, which provide for six instead of four tracks, and increase the strength of the iron road trusses, at an additional cost of $360,000. The Pennsylvania Steel Co. has the contract for building the bridge.

OIL CITY, PA.—Bids are wanted December 12 by S. W. Barnhart, Controller, for building one iron or concrete bridge over Sage run; also for a bridge over Cornplanter run.

PHILADELPHIA, PA.—Plans are being made to open Twenty-fifth street from Diamond street northward. The work includes the building of a railroad bridge to cost, together with the land damages, about $100,000.

The Finance Committee of the City Council will be asked to arrange for building the Passyunk avenue bridge over the Schuylkill river out of the $500,000 originally appropriated for this work.

PHOENIX, ARIZ.—Sealed bids will be received at the office of the United States Reclamation Service, Phœnix, Ariz., until 9 o'clock a.m., Feb. 8, 1905, for building a masonry dam and two bridges over Salt river, 70 miles east of Phœnix. The dam will contain 300,000 cu. yds. of masonry. Specifications and plans may be seen at the office of the Chief Engineer of the Reclamation Service at Washington, D. C., or at the office of the District Engineer of the Reclamation Service at Roosevelt, Ariz. For further particulars, see advertising columns, page 22.

PUTNAM, CONN.—The Consolidated Railroad has agreed to stand a share of the cost of widening Front street, which includes an overhead water tight bridge to carry four tracks.

SACRAMENTO, CAL.—Bids were to be opened Dec. 5, by J. C. Boyd, County Surveyor, for building a steel and iron drawbridge 335 ft. long 20 miles south of this place to cost $45,000.

SEAFORTH, ONT.—McKillop township council will receive bids for the steel superstructures and cement abutments for five new bridges to be built in the township.

THOROLD, ONT.—A new steel bridge will be erected over the Welland Canal at this place.

TOMBSTONE, ARIZ.—Bids are wanted January 2 by the Board of Supervisors for building a steel bridge over the San Pedro river. J. J. Bowen is Chairman.

TORONTO, ONT.—The board has been petitioned to authorize the building of a new bridge to Turner's baths to cost about $7,600 and $2,500 for the approaches.

TOWNERS, N. Y.—In connection with the double tracking of the Highland division the New York, New Haven & Hartford will replace the 1,500 ft. wooden trestle over the valley (and the Harlem division of the New York Central) by a steel structure 185 ft. long. The balance will be filled in.

WILMINGTON, DEL.—Residents of the eastern end are petitioning for a bridge to be built over the Brandywine river.

Other Structures.

BATTLE CREEK, MICH.—The Grand Trunk, reports say, is making surveys to locate the site for locomotive shops.

BUTTE, MONT.—The Northern Pacific, it is expected, will shortly decide to build a union passenger station here.

CHARLOTTE, N. C.—The plans of the Southern for a new passenger station, local reports state, are satisfactory to the city officials, and a dismissal of the proceedings against the railroad will be asked for.

GREENVILLE, S. C.—The Southern, it is reported, is making surveys to locate the site for a new passenger station.

HOMESTEAD, PA.—The Pittsburg & Lake Erie, it is said, is planning to build a new freight house on Fifth avenue near the present station, where a site has been bought for a large station and additional tracks.

HOUSTON, TEX.—The International & Great Northern, reports say, will improve its terminals at a cost of about $100,000.

INDIANAPOLIS, IND.—The Pennsylvania, it is said, is planning to enlarge its car and engine shops on the Indianapolis division in the eastern part of the city. A roundhouse with 40 stalls is also to be built.

JACKSON, OHIO.—The Detroit Southern, it is reported, will soon buy a site for its new shops to be built at this place.

MEMPHIS, TENN.—The St. Louis & San Francisco shops, recently damaged by fire to the extent of $50,000, will be rebuilt at once.

MONTEREY, MEX.—The National of Mexico, it is reported, will spend about $100,000 to improve its yards at this place.

NEWCASTLE, IND.—The Chicago Steel & Manufacturing Co.'s works, destroyed by fire November 8 at a loss of about $100,000, it is reported, will be rebuilt at once.

RITZVILLE, WASH.—The Northern Pacific, local reports state, has plans ready for a new passenger station to cost about $22,000. The old passenger station will be used for a freight house.

VICTORIA, B. C.—The Canadian Pacific is asking bids December 20 for building a seven-story hotel at this place.

WINCHESTER, MASS.—The Boston & Maine, it is reported, will elevate its tracks on Main street and build a subway under its tracks at the station.

WILKESBARRE, PA.—The Pennsylvania, local reports state, has plans ready for removing its present freight house and putting up a new structure 24 ft. wider and 210 ft. long to cost, with yard improvements, about $35,000.

WINNIPEG, MAN.—It is said that the Canadian Northern has decided upon the plans for its new station and that the work will be commenced early next spring.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ATCHISON, TOPEKA & SANTA FE.—An officer writes confirming the report that this company has let a contract to Robert Kinkaid, of Tulsa, Ind. T., for building an extension from Owasso, Ind. T., south to Tulsa, 12 miles. The present southern terminus of the A., T. & S. F. is Owosso. Work will also be begun in a short time on four miles of new line on the Silver Creek & Northern branch between Bayard and Hurley. This line has been located, but the contract has not yet been let. The purpose of this work is to give a better alinement and to secure protection against high water. (December 2, p. 177.)

ALTON, JACKSONVILLE & PEORIA.—Articles of incorporation have been filed by this company in Illinois. It is proposed to build a railroad from Alton to Peoria, with branch lines to Grafton and Jerseyville. Robert Curdie, Alton, Ill.; J. W. Booker, J. N. Page and J. C. McGrath, Jerseyville, Ill., and others are incorporators.

ARIZONA & CALIFORNIA.—Press reports state that about 20 miles of this railroad have been graded out of Wickenburg, Ariz. The line is projected to run from Wickenburg in a westerly direction across the Colorado river to a connection with the Atchison, Topeka & Santa Fe at Bengal, Cal. The Grant Bros. Construction Co., Los Angeles, Cal., has the contract for grading. W. A. Drake, Prescott, Ariz., is the engineer in charge of the work. (May 6, p. 354.)

ARKANSAS, MISSOURI & KANSAS.—Grading is reported completed on the first 25 miles of this road in Cherokee County, Kan., and it is stated that track laying will be begun within 30 days. The proposed route of the road is from Chanute, Kan., southeast through Joplin, Mo., to Memphis, Tenn. W. D. Spooner, Joplin, Mo., is Chief Engineer. (See Construction Supplement.)

ATHENS, FLORAL PARK & NEWNAN AIR LINE.—It is reported that this company is soon to be organized in Georgia to build a

railroad from Athens southwest through Monroe, Floral Park and Fayetteville to Newnan, 70 miles. Ranson Rogers, 625 Empire building, Atlanta, Ga., is said to be interested.

ATLANTA & BIRMINGHAM AIR LINE (S. A. L.).—This company on Dec. 5 opened its extension between Atlanta, Ga., and Birmingham, Ala., 166 miles. The work on this extension has involved a large amount of rock cutting. The new line parallels the Southern between these points. For a full description see *Railroad Gazette* of July 1, page 104. (November 18, p. 160.)

AUGUSTA & FLORIDA.—It is reported that this company, which was recently incorporated in Georgia, proposes to build a railroad from Augusta to Midville, 60 miles. Grading is already in progress. Connection will be made with the Central of Georgia at Midville. W. M. Blount, Union Springs, Ala., is President, and G. H. Burchell, Midville, Ga., Chief Engineer. (November 4, p. 147.)

BAYFIELD TRANSFER.—An officer writes that work is now in progress on an extension from the present terminus of the line to Cornucopia, Wis., seven miles. Location surveys are also in progress for a further extension of the line from Cornucopia to Port Wing, 12 miles.

CHERRY TREE & DIXONVILLE (PENNSYLVANIA-NEW YORK CENTRAL).—This road, which was built jointly by the Pennsylvania and the New York Central, has been opened for traffic between Cherry Tree, Pa., and Possum Glory Junction, 21 miles. It will be operated as a part of the Susquehanna extension of the Cambria & Clearfield division of the Pennsylvania and will open up extensive coal lands in Indiana County. Work is now in progress on an extension from Possum Glory Junction to Dixonville. (July 15, p. 35.)

CHIHUAHUA & PACIFIC.—An officer writes that work is now in progress on an extension from La Junta, Mex., in the State of Chihuahua, Mex., to Temosachic, 55 miles. The contractors are Ryan & Dudley, of Chihuahua, Mex.

CENTRAL ONTARIO.—Surveys have been completed for an extension of this road from its present terminus at Bancroft, Ont., northwest to Whitney, 40 miles. Connection will be made at the latter point with the Canada Atlantic. Grading will probably be begun on this extension early in the spring. J. D. Evans, Trenton, Ont., is Chief Engineer. (March 11, p. 200.)

CLEVELAND, WOOSTER, MT. VERNON & COLUMBUS (ELECTRIC).—Incorporation has been granted this company in Ohio. It is proposed to build an electric railroad connecting Cleveland and Columbus. J. J. Vail, J. B. Graham, G. A. Tilton, F. W. Jones and others, of Columbus, Ohio, are named as incorporators.

COAHUILA GULF R. R.—Incorporation has been granted this company in New York with an authorized capital of $250,000 to build and operate a railroad in Mexico. The proposed route is not stated. J. F. Garner, G. Foster Peabody and E. M. Shepard, all of New York, are named as incorporators.

CUMBERLAND & MOUNT SAVAGE (ELECTRIC).—Incorporation has been granted this company in Maryland to build an electric railroad from Cumberland to Mount Savage, with branch lines from Corrigansville to Elleslie and from Barrowville to the Pennsylvania State line, a total distance of about 20 miles. G. C. Uhl, Mount Savage; W. O. McLean, Frostburg, and others are named as incorporators.

ELGIN, JOLIET & EASTERN.—An officer writes that work is in progress on a branch line from Rockdale, Ill., to Rockdale Junction, seven miles. The contractors are the J. H. Flick Co., Kansas City, Mo., and the Keltic Stone Co., Joliet, Ill. Grading is practically completed and track laying will probably be finished by January 1. Arthur Montzheimer, Joliet, Ill., is Chief Engineer.

GULF & SHIP ISLAND.—An officer writes that this company has completed 15 miles of track during the past year. It is from a point north of Shivers, Miss., to Silver creek. Work is now in progress on an extension from Silver creek to Columbia, 27.6 miles. Bowles & Hemmingway, Jackson, Miss., are the contractors. (October 7, p. 119.)

ILLINOIS CENTRAL.—An officer writes that the change of line between Fort Jefferson and Wicliffe, Ky., is being made because the river frequently overflows the road at this point. The change is about 4½ miles long, starting at a point just north of Wicliffe and extending south. The work involves the removal of about 500,000 cu. yds. of earth. W. J. Oliver & Co., Knoxville, Tenn., have the contract, under the supervision of E. J. Rogers, Assistant Engineer. (November 18, p. 161.)

KALAMAZOO & LAKE SHORE (ELECTRIC).—An officer writes that this proposed electric road is to run from Kalamazoo, Mich., to Benton Harbor, and thence north via Paw Paw Lake to South Haven, a total distance of 80 miles. Work will be begun about January 15. J. A. Mullins, Kalamazoo, Mich., may be addressed. (November 18, p. 161.)

KANSAS CITY, MEXICO & ORIENT.—An officer writes that contracts have been let to the Kaw Valley Construction Co. and the Union Construction Co. for building an extension of this road from Eldorado, Kan., northeast to Matfield Green, in Chase County, 30 miles. The work will be light, with a maximum grade of .6 per cent. westbound and .5 per cent. eastbound. There will be no important bridges or tunnels, but the work will include three long trestles. Location surveys are now in progress for an extension from Minaca, Mex., to El Fuerte, 70 miles. (November 25, p. 169.)

LAKE SHORE & MICHIGAN SOUTHERN.—The newspapers say that this company is making surveys for a cut-off from La Porte, Ind., to Pine, 35 miles. The new line, it is stated, will be built to avoid a large number of curves and heavy grades between these points.

LOWVILLE & BEAVER RIVER.—An officer writes that two miles of track have been laid on this proposed road from Lowville, N. Y., to Croghan, 11 miles. J. T. Campbell, of Lowville, is the contractor. Location surveys have also been completed for a line from Page to Monteola, five miles. J. B. Brownell, Lowville, N. Y., is Chief Engineer. (August 5, p. 51)

MANISTEE & GRAND RAPIDS.—A contract for grading an extension of this road from the present terminus about 1½ miles east of Dighton, Mich., east to Marion, 10 miles, has been let to B. F. Brucker, of Saginaw, Mich. Work is already in progress and the contract calls for the completion of the line by Feb. 15, 1905. Connection will be made with the Ann Arbor Railroad at Marion. Location surveys are now in progress for a further extension from Marion to Gladwin. E. W. Muenscher, Manistee, Mich., is Chief Engineer.

MASSACHUSETTS ELECTRIC ROADS.—R. D. Gillett, President of the Berkshire and the Western Massachusetts Street Railway Companies, says that the proposed electric line to connect Westfield, Mass., with Lee, 30 miles, will probably be built within two years and that work on that portion between Westfield and Huntington will undoubtedly be begun early next spring. Specifications for it are now being prepared.

MEXICAN ROADS.—The Occidental Construction Company has changed its plans about building a railroad from Mazatlan to Topia, State of Durango, and instead it will build a road from Mazatlan to the port of Guaymas, about 300 miles. Application for the concession for the proposed road has been filed with the Mexican government. Harold R. Miller is secretary of the company.

It is announced by the War Department of the Mexican government that it will be probably seven months before the military railroad which the government is building in the new territory of Quintnana Roo, in the State of Yucatan, will be finished. This road is being built from the town of Chan Santa Cruz, to a point on the Gulf coast, and will afford a means of transporting troops into the territory in times of Indian disturbances.

Davis Richardson has obtained a concession from the Mexican government on behalf of the Richardson Construction Company, for building and operating a railroad from the port of Guaymas to the town of Tonichi, situated in the Sahuaripa mining district, in the State of Sonora. According to the concession the road must be completed within six years.

The work of building a railroad from La Dicha south to the port of Marquez, on the Pacific coast, 75 miles, and north from La Dicha to the City of Chilpancingo, is now in progress. It is stated that the Mexican Central will extend its Cuernavaca line south from the Balsas river to Chilpancingo to connect with the new road, thereby making a new through line from the City of Mexico to the port of Marquez.

MISSOURI, OKLAHOMA & GULF.—Press reports state that the route of this proposed road is from Joplin, Mo., southwest through Indian Territory to Denison, Tex., 375 miles. Fifty miles of this line have already been completed under the name of the Muskogee Union. William Kennefick, Kansas City, Mo., is President. (November 18, p. 161.)

MORGANTOWN & KINGWOOD.—Work is progressing fast on an extension of this road from Bretz, W. Va., to Kingwood, 15 miles. Track has been laid as far as Reedsville, 2½ miles from Bretz. Talbott Bros., Reedsville, W. Va., are the contractors. Surveys are now in progress for an extension of the line from Kingwood to Rowlesburg, 18 miles, but work will not be begun on this until the line is finished to Kingwood. A. S. Brady, Morgantown, W. Va., is Chief Engineer. (October 28, p. 139.)

NATCHEZ & WESTERN.—An officer writes that surveys are now in progress for an extension from the Black river, La., to a point near Alexandria, 75 miles.

NORTHERN ALABAMA.—This company has filed a notice with the Secretary of State of its intention to build two miles of track from a point on the main line between Sheffield, Ala., and Parish. This branch line will be known as the Towley Mining Company branch.

ORFORD MOUNTAIN.—An officer writes that during the past year this company has completed its extension from Eastman, Que., to Potton Springs, 12 miles. Work is now in progress on an extension from Kingsbury to Windsor, 10 miles, and the greater part has already been graded and two miles of track have been laid. Location surveys will shortly be begun from Potton Springs to North Troy, 10 miles. H. C. Cleveland, Kingsbury, Que., is Chief Engineer. (See Construction Supplement.)

SALT LAKE & OGDEN.—Work is in progress on an extension of this road from Farmington, Utah, to Kaysville, 3½ miles. Location surveys are being made for an extension from Kaysville to Ogden, 16 miles, and work on this portion of the line will be begun as soon as the first part is completed. E. A. Vail, Salt Lake City, Utah, is Chief Engineer.

ST. LOUIS, BROWNSVILLE & MEXICO.—Negotiations are reported in progress for an extension from Bay City, Tex., to Galveston, 80 miles. Work is now being pushed on the extension from Robstown, Tex., via Sinton, Refugio and Placedo to Bay City, 154 miles. It is probable, however, that grading will not be begun on the extension to Galveston until the line is completed as far as Bay City, which will be in the latter part of 1905. W. P. Homan, Corpus Christi, Tex., is Chief Engineer, and J. N. Miller, General Manager. (September 9, p. 87.)

SOUTHERN INDIANA.—Press reports state that work is progressing fast on the Chicago division of this road and that grading has

been completed on the first section out of Terre Haute for a distance of 16 miles. (October 7, p. 119.)

Thebes Bridge & Western.—Incorporation has been granted this company in Missouri with an authorized capital of $350,000 to build a railroad from the Mississippi river in Scott County, Mo., to the Caster river in Stoddard County, 35 miles. S. M. McCoy, V. O. Boone and others, of Benton, Mo., are named as incorporators.

Toledo & Indiana (Electric).—An officer writes that work is now in progress between Wauseon, Ohio, and Bryan, 23 miles. The contractors are the Patrick Hirsch Construction Co., St. Clair building, Toledo. This road is projected to run from Toledo to Bryan, 58 miles, and is now in operation as far as Wauseon, 25 miles. D. H. Lavenberg, Delta, Ohio, is Chief Engineer. (See Construction Supplement.)

Toledo, Ann Arbor & Detroit.—Incorporation has been granted this company in Ohio with an authorized capital of $1,500,000. The new company will take over the electric lines of the Toledo & Northwestern and the Ohio & Michigan traction companies. J. H. Clauss, Fremont, is President; M. C. Briggs, Fostoria, Vice-President, and C. H. Masters, Toledo, Secretary.

Virginia & Southwestern.—Surveys are reported in progress for a branch line from Tom's Creek, Va., to Clinchport, 38 miles. E. P. Fraser, Bristol, Tenn., is Chief Engineer.

Wadley & Mt. Vernon.—An officer writes that work has been finished on an extension from Douglas, Ga., to Willacoochee, 17 miles. Grading is now in progress between Willacoochee and the Okmulgee river, 37 miles. P. B. Lawrence, Douglas, Ga., is Chief Engineer. (June 10, p. 450.)

West Fork Belt.—Incorporation has been granted this company in West Virginia to build a railroad in Harrison County from a point near Meadowbrook on the West Virginia Short Line to a point near Bloom. J. W. Jacobs, C. H. Jenkins, J. M. Brownfield and others, of Fairmont, W. Va., are incorporators.

Yazoo & Mississippi Valley.—The contract for building the extension of the Roundway branch from Mattson to Roundway, Miss., three miles, has been let to J. E. Murray & Son, of Cedar Rapids, Iowa. Grading will be begun at once. (December 2, p. 178.)

RAILROAD CORPORATION NEWS.

Calgary & Edmonton.—This company has filed a mortgage with the Royal Trust Co. as trustee for the purpose of securing branch-line mortgage bonds to the amount of $1,040,000.

Cleveland & Pittsburg.—Kuhn, Loeb & Co., New York, are offering at 107½ per cent. and accrued interest the unsold balance of the $4,000,000 special guaranteed 4 per cent. betterment stock of this company. The par value of the stock is $50 and the dividends are guaranteed by the Pennsylvania Railroad.

Cleveland, Lorain & Wheeling.—The directors of the Baltimore & Ohio have declared a dividend of 2½ per cent. on the preferred stock of this company. This is the first dividend paid on the stock in several years. It is expected that this amount will be paid semi-annually hereafter, placing the preferred stock of the C., L. & W. on a 5 per cent. basis.

Delaware, Lackawanna & Western.—The directors of this company, at a meeting held on December 6, declared an extra dividend of 10 per cent. on the common stock. The Lackawanna has paid 7 per cent. dividends yearly on its stock since 1886. The stock reached a high record level of 359¾ on December 6, the lowest price this year being 250½ on February 23.

Georgia & Alabama Terminal (Seaboard Air Line).—E. H. Rollins & Sons are offering $300,000 of the total issue of $1,000,000 first-mortgage 5 per cent. gold bonds at 109½. These bonds are guaranteed by the Seaboard Air Line. The mortgage covers terminal property on the Savannah river at Savannah consisting of 940 acres with docks, warehouses, cotton presses, etc.

Guelph & Goderich.—A mortgage has been filed with the Royal Trust Co. as trustee securing an issue of $2,002,500 4 per cent. bonds. This company is subsidiary to the Canadian Pacific and the proceeds from the sale of the bonds will be used to complete the road.

Illinois Central.—This company has sold $12,000,000 of its first-mortgage, purchased lines 50-year 3½ per cent. bonds to Speyer & Co. and Kuhn, Loeb & Co., of New York. The bonds are part of a $20,000,000 mortgage authorized in 1903 and dated June 30, 1904. The proceeds from the sale will be used for general purposes. The bonds are a first-mortgage on all the purchased lines which have been merged in the Illinois Central system.

Interborough Rapid Transit.—At a recent meeting of the directors of this company, a dividend of 3 per cent. was declared on the capital stock payable Jan. 3, 1905. A dividend of 2 per cent. was paid in July, 1904, out of the surplus earnings of the Manhattan Elevated.

Manistee & Grand Rapids.—This company, which operates a road from Manistee, Mich., to Hartwick, 63 miles, with a branch line from Filer City to Sands, 2.3 miles, has been reorganized, and has elected the following officers: John Crocker, President; Max Foltz, Vice-President, and W. M. Simpson, Secretary. The principal business of the company is lumber.

Mississippi Central.—This company, which operates a railroad from Hattiesburg, Miss., to Silver Creek, 55 miles, has given notice of its intention of changing the name to the St. Louis, Pascagoula & Panama.

New York & Ottawa.—See New York Central & Hudson River below.

New York Central & Hudson River.—Negotiations are reported completed for the transfer of the New York & Ottawa Railroad on the date of its foreclosure sale on December 22 to the New York Central. The line runs from Tupper Lake, N. Y., to Ottawa, Ont., 128 miles, connecting with the Rutland Railroad at Moira, N. Y.; with the Grand Trunk at Cornwall Junction, and with the Canadian Pacific at Finch. Tupper Lake is 107 miles north of Utica on the Adirondack division of the New York Central. The New York & Ottawa has been in the hands of a receiver since April, 1900.

St. Louis, Iron Mountain & Southern.—This company has notified the holders of the first-mortgage bonds of the Little Rock & Fort Smith that the principal and interest of the bonds maturing January 1 will be paid at maturity at the office of the Mercantile Trust Co. in New York. Referring to the notice, Kuhn, Loeb & Co. offer in exchange to the holders of the bonds, refunding-mortgage 4 per cent. gold bonds of the St. Louis, Iron Mountain & Southern due July 1, 1929, and also to pay the holders, upon such an exchange, $72.50 per bond in cash. All bonds must be presented on or before December 15.

St. Louis, Pascagoula & Panama.—See Mississippi Central above.

South & North Alabama (L. & N.).—At a recent meeting of the stockholders of this company, which is subsidiary to the L. & N., a mortgage was authorized securing an issue of $2,000,000 bonds. The proceeds from the sale of these bonds will be used for general improvements, double tracking and new equipment.

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EDITORIAL ANNOUNCEMENTS:

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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, except in the advertising columns *our own opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

FRIDAY, DECEMBER 9, 1904.

CONTENTS

EDITORIAL:

Railroad Motor Car Services..... 609
Long Island Railroad..... 611
Editorial Notes 609, 610, 611
New Publications 611
Trade Catalogues 612

ILLUSTRATED:

Problems of Heavy Electric Traction.... 613
Signals at St. Louis Union Station..... 619
Road Tests, Brooks Passenger Locomotives 620
Composite Observation Cars; C.,M. & St. P. 623
Fuel Consumption of Locomotives..... 624
A Concrete Wall Eleven Years Old..... 626
Railroad Shop Tools 628
A Twist-Drill Dynamometer..... 630
Friestedt Steel Sheet Piling..... 632

MISCELLANEOUS:

The Passenger Agent in the Orient..... 612
Testing Steam Boilers..... 618
Wreck of a High Bridge by Wind Pressure 625
The President on Railroad Questions.... 627
Pro-Rating with Shippers' Railroads 631
The Block System on the Vandalia Line. 631

GENERAL NEWS SECTION:

The Scrap Heap 179
Meetings and Announcements 182
Personal 183
Elections and Appointments 184
Locomotive Building 185
Car Building 185
Bridge Building 185
Railroad Construction 186
Railroad Corporation News 188